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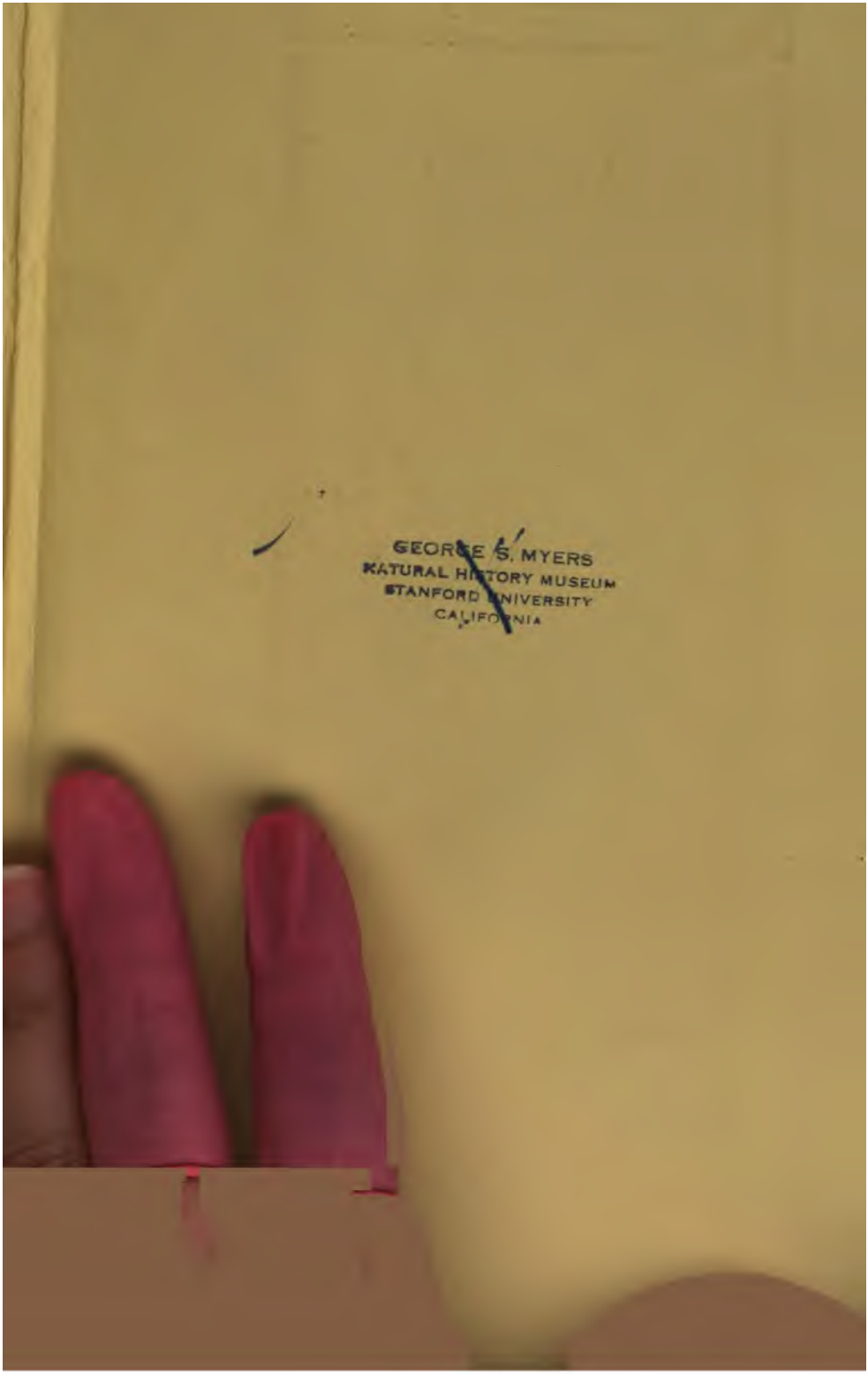
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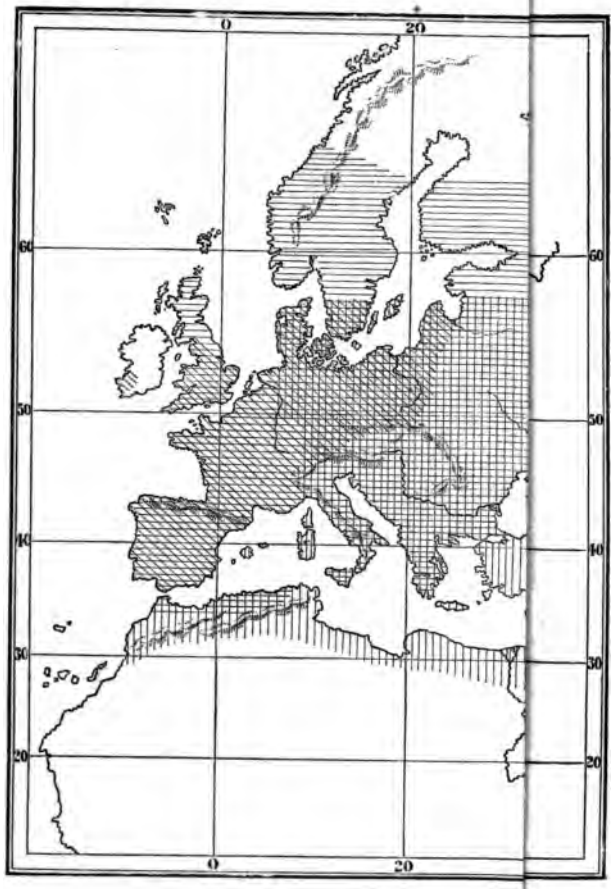


Family 3.—BUFONIDÆ.

Vertebræ procœlous, without autogenous ribs; diapophyses of sacral vertebra dilated. Teeth absent.

This large family, comprising nine genera, is distributed over the whole world except Madagascar, Papuasia, and the islands of the Pacific. Only one genus is represented in the Palæarctic region.

A Himalayan genus, *Cophophryne*, Blgr., founded on a small toad with vertical pupil, and with the sacral vertebra provided with very strongly dilated diapophyses and a single condyle for articulation with the urostyle, effects the passage from the preceding family, from which the true toads differ in the total absence of teeth.

6. Bufo.

Laurenti, Syn. Rept., p. 25 (1768).—Partim.

Pupil horizontal. Vomerine teeth none. Tongue elliptical or pyriform, entire and free behind. Tympanum distinct or hidden. Fingers free, toes more or less webbed; outer metatarsals bound together. Diapophyses of sacral vertebra moderately dilated; two condyles for articulation with urostyle. Omosternum absent; sternum a cartilaginous plate.

Fig. 78.

Open mouth of *Bufo calamita*.

The genus *Bufo*, of which some 100 species are known, has representatives in most parts of the world, with the exception of Madagascar, Papuasia, Australia,

and the islands of the Pacific. Only three species are found in Europe.

Bufo vulgaris has most of the subarticular tubercles under the toes in pairs, no tarsal fold, the interorbital space at least as broad as the upper eyelid, and no vocal sac. *B. viridis* has the subarticular tubercles of the toes single, a tarsal fold, the interorbital space usually distinctly narrower than the upper eyelid, and the male is provided with a vocal sac. *B. calamita* differs from both by its shorter limbs, which preclude it from leaping; the subarticular tubercles of the toes are in pairs as in *B. vulgaris*, but a tarsal fold is usually present, and the interorbital space is narrow; the males have a vocal sac, which is larger than in *B. viridis*, and, when blown, bears great resemblance to that of the common tree-frog. The buccal opening to the sac is a single slit, either on the right side or on the left, as shown on fig. 78, p. 211.

Owing to the fact that *B. viridis* and *calamita* are much more nearly related to each other than to *B. vulgaris*, Fatio and other authors have instituted two different sections or sub-genera, that including the two former species being designated *Rubeta*, the other *Phryne*. An examination of all the species of the genus shows such a division to be untenable. Still less would one feel inclined to follow the view of Cope, who, whilst uniting *B. vulgaris* and *B. viridis* in the genus *Bufo*, isolated *B. calamita* as *Epidalea*, the latter genus being founded solely on the large size of the fronto-parietal fontanelle.

The annexed map shows the interesting distribution over the Palæarctic region of the three species under consideration; *Bufo vulgaris* extending through nearly the whole region, whilst the two closely allied representative species, *B. viridis* and *B. calamita*, occupy the former the East, the latter the West, their respective ranges overlapping on a considerable portion of Central Europe.

Bufo vulgaris. *Bufo viridis.*

9. BUFO VULGARIS.

(Plate XI.)

Rösel, Hist. Ran., p. 85, pls. xx and xxi (1758).
Rana bufo, Linnæus, Syst. Nat., i, p. 354 (1766).
Rana rubeta, Linnæus, l. c.
Bufo vulgaris, Laurenti, Syn. Rept., pp. 28 and 125 (1768); Daudin, Hist. Rain. Gren. Crap., p. 72, pl. xxiv (1803), and Hist. Rept., viii, p. 139 (1803); Eichwald, Zool. Spec. Ross. Pol., iii, p. 167 (1831); Duvernoy, Règne Anim., Rept., pl. xxxviii, fig. 3 (1836); Bonaparte, Icon. Faun. Ital., Rett. Anf. (1839); Bell, Brit. Rept., p. 105, fig. (1839); Duméril & Bibron, Erp. Gén., viii, p. 670 (1841); Nilsson, Skand. Faun., Amf., p. 99 (1842); Guichenot, Explor. Sc. Alg., Rept., p. 27 (1850); Günther, Cat. Batr. Sal., p. 569 (1858); Strauch, Erp. Alg., p. 79 (1862); Günther, Rept. Brit. Ind., p. 419 (1864); Collin, Naturh. Tidsskr. (3), vi, 1869, p. 325; Sahlertz, Vid. Meddel., 1871. p. 131; Fatio, Vert. Suisse, iii, p. 587 (1872); De Betta. Faun. Ital., Rett. Anf., p. 72 (1874); Schreiber, Herp. Eur., p. 134 (1875); Lataste, Herp. Gir., p. 283, pl. xi (1876); Leydig, An. Batr., p. 12 (1877); Lessona, Atti Acc. Linc., Mem. Cl. Sc. fis., i, 1878, p. 1080, pl. iv; Boulenger, Proc. Zool. Soc., 1880, p. 569, and Cat. Batr. Ecaud., p. 303 (1882); Camerano, Mem. Acc. Torin. (2), xxxv, 1883, p. 235; Héron-Royer, Bull. Soc. Et. Sc. Angers (2), xvi, 1887, p 96; Bedriaga, Bull. Soc. Nat. Mosc., 1889, p. 353. and Amph. Rept. Portug., p. 11 (1889); Héron-Royer & Van Bambeke, Arch. Biol., ix, 1889, p. 291; Boulenger, Ann. & Mag. N. H. (6), v, 1890, p. 141, Trans. Zool. Soc., xiii, 1891, p. 159, and Proc. Zool. Soc., 1891, p. 612, pl. xlvi, fig. 4; Méhely, Beitr. Mon. Kronstadt, Herp., p. 65 (1892); Minà-Palumbo, Nat. Sicil., xii, 1893, p. 282; W. Evans, Proc. Phys. Soc. Edinb., xii, 1894, p. 512; Martin & Rollinat, Vert. Dép. Indre, p. 338 (1894); Werner, Rept. Amph. Oesterr.-Ung., p. 96 (1897); Dürigen, Deutschl. Amph., p. 467, pl. i, fig. 1 (1897).
Bufo cinereus, Schneider, Hist. Amph., i, p. 185 (1799); Daudin, Hist. Rain. Gren. Crap., p. 73, pl. xxv, and Rept., viii, p. 141; Brandt & Ratzeburg, Med. Zool., p. 193, pl. xxiii, fig. 1 (1829); Gravenhorst, Delic. Mus. Vratisl., p. 62 (1829); Koch, Ber. Senck. Ges., 1872, p. 174.
Bufo rubeta, Schneider, l. c., p. 227; Boscá, Bull. Soc. Zool. France, 1880, p. 255.
Bufo roeselii, Daudin, Hist. Rain. Gren. Crap., p. 77, pl. xxvii, and Rept., viii, p. 150, pl. xcvi.
Bufo ventricosus, Daudin, Hist. Rain., p. 83, pl. xxx, and Rept., p. 168.
Bufo spinosus, Daudin, Hist. Rept., p. 199.
Rana scorodosma, Hermann, Observ. Zool., p. 243 (1804).
Bufo prætextatus, Boie, Isis, 1826, p. 215.
Bufo palmarum. Cuvier, Règne Anim., 2nd ed., ii, p. 111 (1829) Bibron & Bory de St. Vincent, Expéd. Sc. Morée, iii, p. 75, pl. xv, fig. 1 (1832).

Bufo colchicus, Eichwald, l. c.
Bufo minutus, Schinz, Nat. Rept., p. 235, pl. xcvi, fig. 4 (1833).
Bufo alpinus, Schinz, l. c., p. 236, fig. 5, and Faun. Helv., p. 145 (1837).
Bufo vulgaris japonicus, Schlegel, Fauna Japon., Rept., p. 106, pl. ii (1836); Lataste, Bull. Soc. Zool. France, 1880, p. 66.
Bufo vinearum, Lesson, Act. Soc. Linn. Bord., xii, 1841, p. 61, pl. iv, fig. 1.
Bufo gargarizans, Cantor, Ann. & Mag. N. H., ix, 1842, p. 483.
Bufo commutatus, Steenstrup, Ber. 24. Vers. Deutsch. Naturf. Kiel, 1847, p. 134.
Bufo griseus, Hallowell, Proc. Ac. Philad., 1860, p. 506.
Bufo communis, Bruch, Würzb. Naturw. Zeitschr., iii, 1862, p. 185.
Bufo japonicus, Camerano, Atti Acc. Torin., xiv, 1879, p. 884.
Bufo rubeta, var. *robustior* (Lataste), Boscá, Bull. Soc. Zool. France, 1880, p. 256.
Bufo spelæus, Rivière, C. R. Assoc. Franç., xv, 1887, p. 453.

FIG. 79.

Upper view of head (♀, Paris).

Head once and one-fifth to once and two-thirds as broad as long; snout as long as or a little shorter than the diameter of the orbit, short and blunt, with obtuse canthus and very oblique grooved lores; nostrils equally distant from the eyes and the tip of the snout, or somewhat nearer the former; eyes nearer the tip of the snout than the angles of the jaws; interorbital space flat, in old specimens slightly concave, its width at least equal to that of the upper

eyelid, and greater than the distance between the nostrils; tympanum hardly half the diameter of the eye, usually indistinct except anteriorly, sometimes quite hidden under the tubercular skin (larger and more distinct in specimens from Eastern Asia); cleft of the mouth extending beyond the level of the posterior border of the eyes.

Fingers rather short, blunt or obtusely pointed; third longest, second and fourth equal and scarcely shorter than the first; subarticular tubercles mostly in pairs; two large palmar tubercles, one larger and rounded in the middle, and the other smaller and oval at the base of the inner digit.

Hind limb moderately elongate; the tarso-metatarsal articulation reaches the tympanum or the eye in the male, the shoulder or the tympanum in the female; tibia considerably longer than the head, as long as the thigh, the heels meeting or nearly meeting when the limbs are folded at right angles to the rhachis. Toes moderately elongate, depressed, nearly entirely or at least two-thirds webbed in the breeding male, one-half to two-thirds webbed in the female; the free border of the web often scalloped or crenulate; subarticular tubercles small and in pairs, at least under the fourth toe; two large metatarsal tubercles, the inner very prominent and oval, the outer flatter and rounded. No tarsal fold.

Upper surfaces covered with anastomosing wrinkles, and irregular, more or less prominent, often spinous warts, the pores of which may be very indistinct to the naked eye. Japanese specimens are remarkable for the greater prominence of the warts, which are very spinous; the Chinese have also the warts very prominent, but often more elongate, as if two had merged into one. A large, prominent, elliptical or oval parotoid gland on each side behind the eyes, with the inner border diverging behind; the length of this gland contained once and one-sixth to once and a half in the length of the head. Lower surfaces

granular, the granules being larger and more distant from one another on the lower belly and under the thighs; these granules may be tipped with horny spines, which are often black, especially in old females.

Brown, olive, greyish, or red above, uniform, or with dark brown or blackish spots or marblings; some females handsomely marbled with dark brown, with yellow spots between the marblings, others pale olive with rusty spots; females and young often with the parotoids and the larger warts brick-red; parotoids (with rare exceptions) margined on the outer side with dark brown or black, which may extend as a band along the upper side of the flanks, this being more usually and markedly the case in Chinese and Japanese specimens. In these Oriental specimens a fine yellow vertebral line is often present. Lower surfaces dirty white, greyish, or brownish, often flesh-colour under the thighs, uniform, or more or less spotted with brown or blackish; these spots are very large, and often form handsome marblings in Asiatic specimens. Iris red or copper-colour, more or less vermiculated with black, rarely (in males) golden, scarcely tinged with red.

Fig. 80.

Lower view of left hand of male.

Male distinguished from the female by much stronger, more muscular fore limbs, fuller webs between the toes, a shorter body, usually a smoother skin, and, during the breeding season, by the presence of black, horny spinules forming bands on the inner upper side of the three inner fingers and the inner carpal tubercle. These excrescences sometimes persist long after the pairing is over; Boscá, in Spain, at Valencia, noticed males bearing them in August and December, and I have found them well developed in English specimens captured on land in August and September. Vocal sacs are absent. The male is smaller than the female, the disproportion

being greatest in specimens from Northern and Central Europe.

E. Olivier has recorded the very extraordinary case of an adult specimen in which the notochordal larval tail had not only been retained, but had continued to grow in proportion with the animal. The specimen, which measures 63 mm. from snout to vent, with a tail-length of 54 mm., is figured in the Revue Scientifique du Bourbonnais, vi, 1893, pl. ii. It was obtained near Jaligny, in the Department Allier.

MEASUREMENTS (in millimetres).

	♂			♀				
	1.	2.	3.	4.	5.	6.	7.	8.
From snout to vent	57	76	92	94	102	132	130	112
Length of head	16	18	21	22	22	29	30	23
Width of head	20	24	32	34	35	50	50	38
Diameter of eye	5	6	7	7	8	9	9	8
Interorbital width	5	6	6·5	7	7	11	11	7·5
From eye to nostril	3·5	4	5	5·5	5·5	7	7	6
,, end of snout	7	8	10	11	11	15	15	12
Length of parotoid	11	13	18	18	18	24	27	20
Width of parotoid	5	7	11	9	10	12	12	9
Fore limb	41	51	57	59	62	85	85	67
Hind limb	78	97	111	98	122	160	150	120
Tibia	21	27	33	30	36	47	46	37
Foot	30	36	38	36	43	55	54	44

1. Chiddingfold, Surrey: Boulenger.
2. Denmark: Lütken.
3. Algiers: Anderson.
4. Isle of Arran: Leach.
5. Jersey: Hornell.
6. Paris: Boulenger.
7. Gerez, Portugal: Vieira.
8. Sicily.

Fatio records a female specimen from Sicily measuring 153 mm. from snout to vent. The largest male from the same island, examined by Camerano, measures 95 mm. According to Minà-Palumbo, the species grows to 180 mm.

GEOGRAPHICAL VARIATIONS.—The differences between European and Japanese specimens are considerable, and have induced some authors to regard the two as distinct species. These differences, which reside chiefly in the greater size and perfect distinctness of the tympanum, the black lateral stripe, and the deep black spots or marblings of the lower parts in the

latter, are completely bridged over when the Chinese and Manchurian specimens are taken into consideration. Specimens from Ichang, on the Yangtse Kiang, and Ningpo come nearest the Japanese, from which they do not differ in coloration; but the tympanum, although as distinct, is not so large. Others from Shanghai, Chefoo, Peking, and Corea are intermediate between the latter and the European; the tympanum is always very distinct (as is also sometimes the case in European specimens), but varies considerably in size; the dark lateral stripe is often ill-defined or absent, and the belly may be either largely spotted with black, or almost immaculate. Specimens from Chabarowka, Manchuria, the northernmost Oriental locality, are still nearer the European; the tympanum is rather small, but perfectly distinct; the belly is immaculate, and the coloration might be said to be identical but for the presence of traces of a light vertebral line, as is often found in specimens from Japan, Corea, and Northern China.

Measurements of specimens from Eastern Asia are appended for comparison with those of Europeans, as given in the preceding table.

Measurements of Asiatic Specimens (in millimetres).

	♂				♀		
	1.	2.	3.	4.	5.	6.	7.
From snout to vent	65	88	87	120	120	102	132
Length of head	16	21	22	29	28	26	35
Width of head	22	30	34	47	45	41	56
Diameter of eye	7	7	7	9	9	8	11
Interorbital width	6·5	7	8	9	10	11	12
From eye to nostril	4	4·5	5	6	7	6	9
,, end of snout	8	10	11	14	14	12	18
Diameter of tympanum	3	3	4	7	6	5	8
Length of parotoid	13	14	15	23	20	24	26
Width of parotoid	7	6	9	10	10	10	10
Fore limb	46	55	67	82	66	66	83
Hind limb	85	115	123	150	125	130	157
Tibia	24	33	36	44	42	40	50
Foot	32	44	43	54	48	44	52

1. Chabarowka: Dörries.
2, 5. Corea.
3. Chefoo: Swinhoe.
4, 7. Japan.
6. Ichang: Pratt.

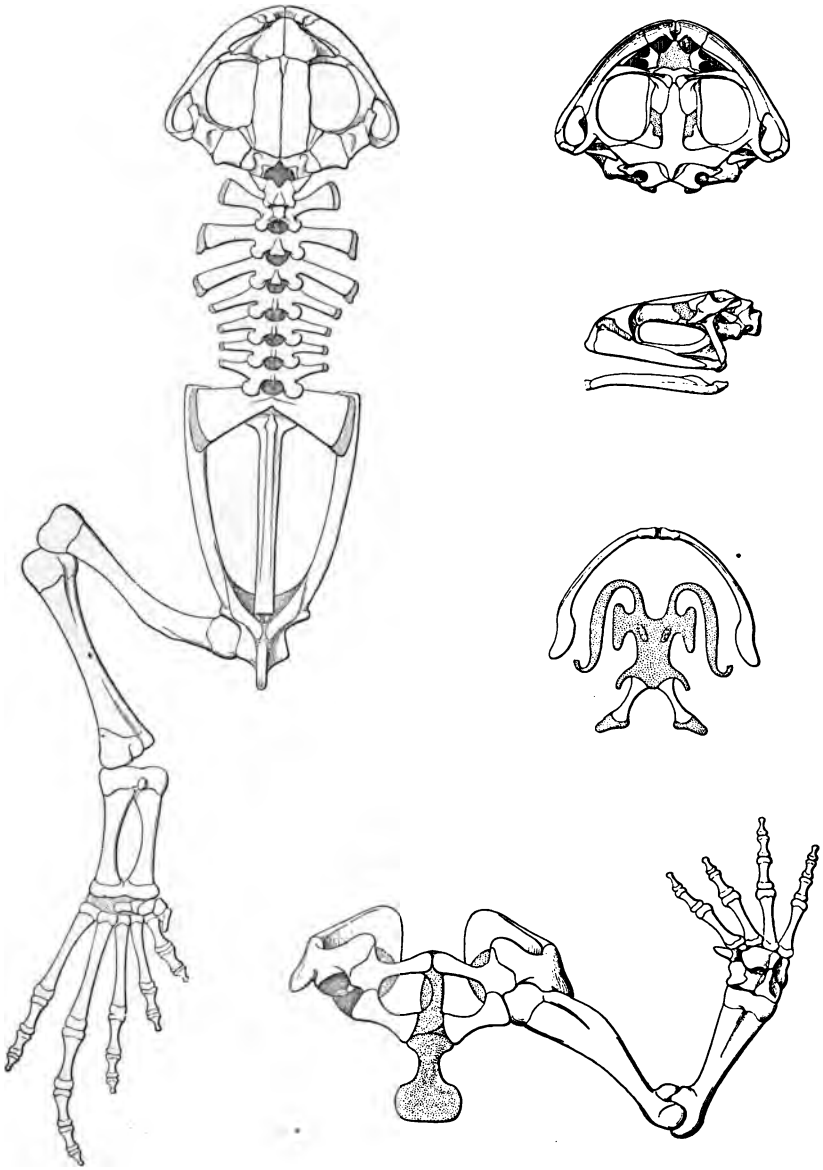
SKELETON.—Skull strongly ossified. Ethmoid entirely or nearly entirely covered over by the fronto-parietals and the large, subtriangular or pear-shaped nasals, the two paired bones being in contact with each other, and forming a continuous or subcontinuous median suture. Squamosal forming a suture with the prootic, its zygomatic process very short. Of the three branches of the pterygoid, the anterior is the longest and the broadest, and joins the maxillary and the palatine; the inner branch extends to the parasphenoid, which is dagger-shaped, obtuse or truncated anteriorly, and in contact with the palatines. Latter bones strong, with sharp lower keel. Vomers very small, widely separated from each other. Mento-Meckelian bones distinct.

Hyoid much longer than broad, with moderately broad cornua without anterior processes, small alæ, short postero-lateral processes, and slender, diverging, ossified thyroid processes, which are narrowly separated from each other at the base. In old specimens a small ossification is present on each side of the body of the hyoid, just behind the level of the anterior notch.

Diapophyses of second vertebra much flattened and directed forwards; of third vertebra also much flattened, longer, and horizontal; of fourth a little longer still, less flattened, and directed backwards. The four following diapophyses slender and subcylindrical, gradually decreasing in length to the last or the last but one, the first two directed backwards, the other two horizontal. Diapophyses of sacral vertebra dilated, subtriangular, their distal diameter equal to or a little less than their length. Two condyles for articulation with the urostyle. Latter nearly as long as or shorter than the rest of the vertebral column, a little longer than the skull, with strong dorsal crest, but no processes at the base save exceptionally.

Præcoracoids strong, feebly curved, nearly horizontal, entering the glenoid cavity; coracoids slightly

FIG. 81.



Skeleton of female.

curved, directed obliquely backwards, expanded at both extremities; no omosternum; sternum an elongate cartilaginous plate expanded distally, calcified along the middle in adult specimens. Supra-scapula nearly entirely ossified. Humerus once and two-fifths to once and a half as long as radius-ulna, with strong crest; both bones with calcified epiphyses. Six bones in the carpus, three in contact with radius-ulna; a single bone to the pollex.

Pelvis two-thirds or rather more than two-thirds the length of the vertebral column; ilia subcylindrical at their free ends, which are covered by the diapophyses of the sacral vertebra; pubis ossified or calcified, entering the acetabulum. Femur moderately curved, as long as or slightly longer than tibia-fibula; both bones with calcified epiphyses; astragalus and calcaneum subequal in length, united at both ends by a common calcified epiphysis; the tarsus not quite half as long as the femur. Three distal tarsals, and two bones to the præhallux. Distal phalanges obtuse, slightly expanded at the apex.

Measurements of Skeleton (in millimetres).

	♂		♀
Length of skull	22	...	28
Width of skull	30	...	39
Least interorbital width	6	...	8
Dorsal vertebral column	32	...	40
Urostyle	28	...	34
Humerus	36	...	36
Radius-ulna	24	...	26
Manus	23	...	31
Pelvis	40	...	51
Femur	35	...	41
Tibia	33	...	38
Tarsus	19	...	22
Pes	42	...	45

Habits.—The Common Toad is a terrestrial and crepuscular Batrachian, living in holes and crevices, and issuing forth at dusk in search of insects, worms, and slugs, which it catches, after careful aiming, accompanied by nervous movements of the tips of the

toes, by darting, with lightning rapidity, its exsertile slimy tongue. Its movements on land are slow, partly by crawling, partly by short leaps. In the water, to which it resorts once a year for the purpose of breeding, it proves no bad swimmer, owing to the well-developed web of the feet. Its intelligence is greater than that of any other Batrachian; in captivity it soon accommodates itself to its surroundings, understands that a glass partition is an obstacle, and, placed on a table, will not attempt to jump off, whilst a frog will not hesitate to take a leap from a fifth-story balcony. It is, therefore, easily tamed, answering the call of its master to take food from the hand, or flattening itself down to let him stroke its back. A large Jersey specimen I kept for twelve years, raised its head and came out of its place of concealment when I knocked on the glass front of its terrarium; it did not evince the slightest timidity,—in fact, liked being handled, and was ever ready to take food. In its excessive greediness it would swallow so many large earthworms in succession that, after a time, they were passed alive; on two occasions it disposed of whole litters of new-born mice. T. Bell has recorded, on the authority of the Rev. John Phillips, of Ninfield, Sussex, the curious case of a toad attempting to swallow a viper. Although crepuscular, this toad occasionally leaves its retreat in the daytime, namely, during thunderstorms. Specimens are also not infrequently met with in the daytime, crawling about in great pain, with the snout or even the greater part of the head a deep sore, swarming with dipterous larvæ.

The question whether the flies that select toads for the rearing of their maggots constitute a distinct form (*Lucilia bufonivora*, Moniez), like the Australian *Batrachomyia*, or not, has been much discussed among entomologists, but I believe the balance of opinion now is that various species resort to that host, on which they are to be regarded as predatory, not

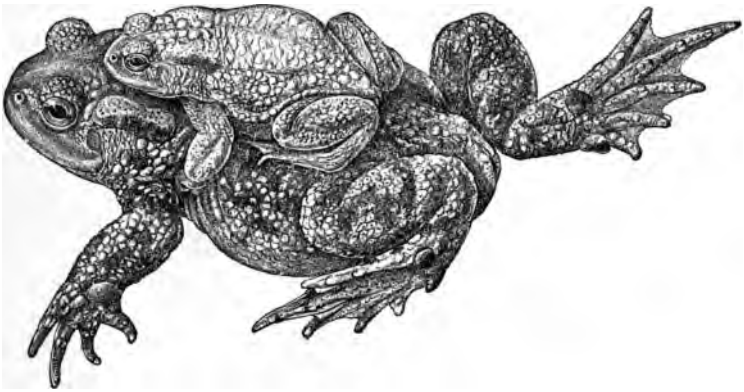
parasitic, since its life is speedily destroyed. The larvæ have been mostly referred to *Lucilia silvatica* and *Calliphora erythrocephala*. It has been suggested that the eggs may have been laid in the mouth of the toad whilst feeding, but it appears to me more probable that certain flies simply avail themselves of ulcers, from which these Batrachians not uncommonly suffer, especially about the snout; in which case the nasal cavities become converted into a nursery, whence the swarming larvæ soon spread to the eyes and brain, until the whole head is eaten away, leaving nothing but the skull partly covered by the tough integument.

Owing, no doubt, to the necessity for securing food in greater quantity, young specimens are more diurnal, and may be found in the daytime going about in damp places in woods or other shady localities. During periods of drought myriads of tiny toads, which have been compelled to leave the water after the metamorphosis, conceal themselves under stones and in fissures in the soil, whence they emerge all at a time during or after a heavy shower in such numbers that it is sometimes impossible to walk along a path without crushing a lot. Such sudden apparitions have given rise to the idea of showers of toads.

Pairing takes place from two to four weeks later than in the common frog; in England between the end of March and the middle of April, somewhat earlier in warmer latitudes, and as late as the beginning of May in Norway, when toads congregate in large numbers in ponds and pools, very rarely in shallow ditches. The males are always much the more numerous, and quarrel with rage over the females; their cry resembles the distant barking of a little dog. The male seizes the female by poking the clenched fists in the axils, and the embrace is so frantic that it is extremely difficult to dislodge him. Individuals of the former sex are usually smaller, and it is not rare to find a young male paired with a female at least twice his length. If the weather be

cold, pairing may last a fortnight or more; otherwise the breeding operations are concluded within a week, only males that have failed in finding a mate remaining a little longer in the water, swimming about in great anxiety and clasping frogs or toads of other species, even occasionally fishes, or any object, such as a pole or fishing-net, that may be held out to them.

FIG. 82.



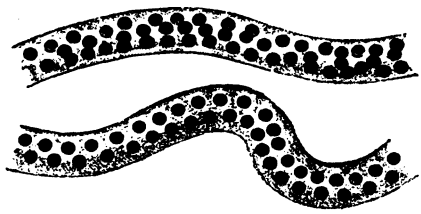
Male and female pairing.

The eggs come out slowly, in several hours, in two distinct strings from the oviducts, and they are impregnated in several emissions. The male assists with his toes in pulling out the strings; and the female, by winding round during oviposition, twists them about water plants or submerged branches of trees, usually not far from the borders. The young leave the water eight to twelve weeks later, measuring 8 to 12 mm. from snout to vent. In a very interesting paper on "The Reptiles and Batrachians of the Edinburgh District," W. Evans records finding a pair of common toads in a deep pool in an old limestone quarry in East Lothian (practically at sea level) in the very act of spawning so far on in the season as the 13th of June, 1894. This is the more remarkable from the fact that the common toad and the

common frog may be regarded as the two European types in which there is least individual divergence in the breeding-time. Rollinat also reports having met with an isolated breeding couple near Argenton, in France, on the 18th of June, 1893. In the spring of 1897 I captured a pair in a pond at Anseremme, near Dinant, Belgium, on April 29th, about three weeks late; the female, a large specimen, spawned the following day.

Eggs.—Small, $1\frac{1}{2}$ to 2 mm. in diameter, entirely black, in regular files of three or four (two when stretched), in long mucilaginous strings looking like glass tubes.

Fig. 83.



The eggs number 4972 to 6840 according to Héron-Royer's counting, 1911 to 4152 in three broods counted by W. Evans. The strings measure (with the eggs in double file) 9 or 10 feet, and can be stretched out to a much greater length. The egg is protected by a second mucilaginous envelop within the string. The mucilages soon partially dissolve and release the embryo, which, so to say, drops out before it is able to execute any spontaneous movements, before the appearance of the external gills and with a very rudimentary tail, and becomes fixed by its adhesive subcephalic apparatus to the outside of the string, on which long lines of embryos may be seen hanging motionless.

Tadpole (Pl. II, fig. 3).—Length of body about once and a half its width, and three-fifths to two-thirds the length of the tail. Nostrils much nearer the eyes than the end of the snout. Eyes on the

upper surface; the distance between them about twice as great as the distance between the nostrils, and equal to or somewhat less than the width of the mouth. Spiraculum on the left side, directed backwards, nearly equidistant from either extremity of the body, not very prominent, but visible from above and from below. Anus median. Tail three or four times as long as deep, broadly rounded at the end; both crests nearly equal in depth, with nearly straight and parallel edges; the depth of the muscular part of the tail, at its base, two-fifths the greatest total depth.

Beak white, broadly edged with black. Lips with papillæ only at the sides, which form an inward fold; both upper and lower edges toothed, the series of labial teeth being $\frac{2}{3}$; the second upper series nearly as long as the first, and very narrowly interrupted in the middle; the three lower series uninterrupted, and occupying nearly the whole width of the lip.

Lines of muciferous crypts not or scarcely traceable. Blackish-brown or black above, blackish-grey beneath. muscular part of tail dark brown or blackish; crests grey, finely speckled, as if powdered with black.

The tadpole of this, the largest European Batrachian, is very small. The largest specimen measured by me is 32 mm. long; body, 12; width of body, 8; length of tail, 20; depth of tail, 5.

Habitat.—The common toad inhabits nearly the whole of Europe, northwards to 65° lat.; it is, however, absent from some of the larger islands—Ireland, Corsica, Sardinia, and the Baleares. It ascends to an altitude of 7000 feet in the Alps. In North-west Africa it is on record from Larache in Morocco, and Tlemsen, Algiers, and Bona in Algeria. It extends across northern and temperate Asia to Manchuria, Japan, China, and Thibet up to 10,000 feet. The altitude of 17,000 feet previously recorded by me is based on an error; the specimen collected by Mr. Pratt in the province of Sze Chuen, China, came from an altitude of only 1700 feet.

4.

5.

1.

2.

3.

Bufo viridis.

The specimen figured on Pl. XI is a female from Jersey, which I have kept alive from 1885 to 1897, and to which I have alluded above.

10. Bufo viridis.

(Plates XI and XII.)

Bufo viridis, Laurenti, Syn. Rept., pp. 27 and 111, pl. i (1768); Sparrman, Vetensk. Ac. Handl. Stockholm, xvi, 1795, p. 183, pl. vii; Schneider, Hist. Amph., i, p. 200 (1799); Daudin, Hist. Rain. Gren. Crap., p. 79, pl. xxviii, fig. 2 (1803), and Hist. Rept., viii, p. 156 (1803); Bonaparte, Icon. Faun. Ital., Rett. Anf. (1838); Günther, Cat. Batr. Sal., p. 58 (1858); Strauch, Erp. Alg., p. 79 (1862); Bruch, Würzb. Naturw. Zeitschr., iii, 1862, p. 185; Steindachner, Novara, Amph., p. 39 (1867); Collin, Naturh. Tidsskr. (3), vi, 1869, p. 336; Stoliczka, Journ. As. Soc. Beng., xxxix, 1870, p. 155; Fatio, Vert. Suisse, iii, p. 411 (1872); Koch, Ber. Senck. Ges., 1872, p. 170; De Betta, Faun. Ital., Rett. Anf., p. 74 (1874); Lessona, Atti Acc. Linc., Mem. Cl. Sc. fis., i, 1877, p. 1085, pl. iv; Boulenger, Proc. Zool. Soc., 1880, p. 553, pl. l, and Cat. Batr. Ecaud., p. 297 (1882); Camerano, Mem. Acc. Torin. (2), xxxv, 1883, p. 336; Héron-Royer, Bull. Soc. Zool. France, 1884, p. 29, and Bull. Soc. Et. Sc. Angers (2), xvi, 1887, p. 134; Walter, Zool. Jahrb., iii, 1888, p. 983; Héron-Royer, Bull. Soc. Zool. France, 1888, p. 26; Bedriaga, Bull. Soc. Zool. France, 1888, p. 220, and Bull. Soc. Nat. Mosc., 1889, p. 378; Héron-Royer & Van Bambeke, Arch. Biol., ix, 1889, p. 293; Boulenger, Faun. Ind., Rept., p. 504 (1890), Trans. Zool. Soc, xiii, 1891, p. 158, and Proc. Zool. Soc., 1891, p. 612, pl. xlvi, fig. 5; Méhely, Beitr. Mon. Kronstadt, Herp., p. 69 (1892); Camerano, Boll. Mus. Torin., viii, 1893, No. 162, p. 3; Minà-Palumbo, Nat. Sicil., xii, 1893, p. 284; Werner, Rept. Amph. Oesterr.-Ung., p. 98 (1897); Dürigen, Deutschl. Amph., p. 481, pl. i, fig. 2 (1897).

Bufo schreberianus, Laurenti, l. c., p. 27.

Rana variabilis, Pallas, Spicil. Zool. vii, p. 1, pl. vi, figs. 3 & 4 (1769); Sturm, Deutschl. Faun., iii, Heft 2 (1799).

Rana sitibunda, Pallas, Reise Russ. R., i, p. 458 (1771).

Rana bufina, Müller, Prodr. Zool. Dan., p. 35 (1776); Retzius, Faun. Suec., p. 283 (1800).

Bufo viridi-radiatus, Lacépède, Quadr. Ov., i, Syn. Méth., & p. 588 (1788).

Rana viridis, Lindaker, Abh. Böhm. Ges. Wiss., i, 1791, p. 123.

Bufo sitibundus, Schneider, Hist. Amph., i, p. 225 (1799).

Bufo cursor, Daudin, Hist. Rept., viii, p. 164 (1803).

Bufo variabilis, Merrem, Tent. Syst. Amph., p. 180 (1820); Brandt & Ratzeburg, Med. Zool., p. 197, pl. xxiii, figs. 2 & 11 (1829); Gravenhorst, Delic. Mus. Vratisl., p. 63 (1829); Eichwald, Zool. Spec. Ross. Pol., iii, p. 167 (1831); Nilsson, Skand. Faun., Amf., p. 102 (1842); Schreiber, Herp. Eur., p. 138 (1875); Leydig, An. Batr., p. 29 (1877).

Bufo arabicus, Rüppell, Atl. Reise N. Afr., Rept., p. 20, pl. v, fig. 2 (1827); Héron-Royer, Mém. Soc. Zool. France, iv, 1891, p. 78.
Bufo longipes, Fitzinger, in Bonaparte, Mem. Acc. Torin (2), ii, 1839, p. 249.
Bufo viridis, part., Duméril & Bibron, Erp. Gén., viii, p. 681 (1841).
Bufo calamita, Günther, Rept. Brit. Ind., p. 426 (1864).
Bufo boulengeri, Lataste, Rev. Int. Sc., iii, 1879, p. 438.
Bufo variabilis, var. *balearica*, Boettger, Zool. Anz., 1880, p. 642.

FIG. 84.

Upper view of head and scapular region.
A. Berlin. B. River Ili. C. Nukuss, Amu Daria.

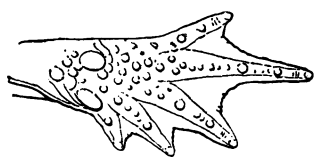
Head once and one-fourth to once and a half as broad as long; snout scarcely prominent, with distinct though obtuse canthus, as long as or a little longer than the diameter of the orbit; nostrils equally distant from the eyes and the tip of the snout, or somewhat nearer the latter; eyes equally distant from the tip of the snout and the angles of the

jaws; interorbital space flat and narrow, its width equalling two-thirds to four-fifths that of the upper eyelid, not or but little greater than the distance between the nostrils; tympanum distinct, at least in the anterior half, rounded or a little deeper than broad; its transverse diameter equals usually about half that of the eye, sometimes only one-third; cleft of the mouth extending to below the posterior corner of the eye or slightly beyond.

Fingers rather short, obtuse; third longest, second and fourth nearly equal, first usually a little longer, exceptionally equal to second; subarticular tubercles single, or partly single, partly in pairs; two large palmar tubercles, one large, flat, and rounded in the middle, the other smaller and oval, at the base of the inner finger.

Hind limb moderately elongate, in some females from Algeria and Syria very short; the tarso-metatarsal articulation reaches the eye or between the eye and the nostril in the male, between the shoulder and the posterior border of the eye in the female; tibia as long as or a little longer than the thigh, the heels meeting or slightly overlapping when the limbs are folded at right angles to the rhachis, considerably longer than the head, shorter than the foot. Toes moderately

FIG. 85.



Lower view of foot of male.

elongate, depressed, one-half to three-fourths webbed, the web extending as a fringe to the tips; subarticular tubercles prominent and single; two metatarsal tubercles,—inner large, oval, prominent, outer smaller, oval or rounded. A fold along the inner side of the tarsus.

Back covered with more or less prominent, sometimes spinous, distinctly porous warts of various sizes; those at the angles of the mouth much developed; a series of large prominent warts usually extends along each side of the body. Lower parts granulate. Parotoid glands very variable in shape; usually parallel or converging backwards, more or less pear- or kidney-shaped, the greatest width in front about twice as long as broad, and nearly as long as their distance from the end of the snout; sometimes, especially in Asiatic specimens, shortly oval, or enormously large, much longer than the head, and once and a half to twice as long as broad. The parotoids always depressed, and anteriorly in contact with or very narrowly separated from the upper eyelids. Upper surface of forearm and tibia more or less glandular, sometimes, especially in some Algerian and Central Asian specimens, with a parotoid-like gland as in *B. calamita*.

Coloration very variable. Greyish, greenish, yellowish, brownish, pinkish, or whitish above, usually with large, irregular, insuliform, distinct or confluent spots, varying from bright green to dark olive, and often margined with black; these markings sometimes interrupted on the vertebral area, or forming wavy longitudinal bands; a fine yellow vertebral line sometimes present; the larger warts at the angles of the mouth, on the sides of the body, and sometimes also on the back, brick-red or crimson. Lower parts dirty white, uniform, or with more or less abundant blackish or olive spots. Tips of fingers and toes and metatarsal tubercles usually brown. Iris greenish-yellow, veined or vermiculated with black.

It is a remarkable fact that the occasional presence in this species of a yellow vertebral line, such as is usually present in, and has been regarded as a specific character of, *B. calamita*, has never been observed in Germany and Denmark, where the allied species coexists, whilst it is by no means uncommon in Italy, in

South-eastern Europe, in South-western Asia, and in North Africa, and has more than once given rise to erroneous statements as to the distribution of *B. calamita*. It also seems as if this line were occasionally absent in the latter species only in those countries where *B. viridis* does not exist. In Eastern Asia, where neither *B. viridis* nor *B. calamita*, nor any other species with such a line occurs, the same character is assumed by some specimens of *B. vulgaris*, which thus take the place of their absent congeners so far as this conspicuous marking is concerned.

Male distinguished by much stronger fore limbs, a large callosity on the inner side of the first finger, fuller webs between the toes, a small, feebly pigmented internal vocal sac, and, during the breeding season, blackish horny excrescences forming bands on the inner-upper side of the three inner fingers and the inner carpal tubercle; the extent of this band on the inner finger is much greater than in the two other species of this genus, and is borne on a pad having some resemblance to that of *Rana temporaria*.

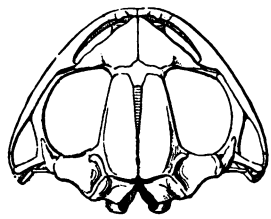
MEASUREMENTS (in millimetres).

	♂				♀			
	1.	2.	3.	4.	5.	6.	7.	8.
From snout to vent	71	82	72	77	79	85	87	93
Length of head	18	19	17	18	17	20	20	21
Width of head	25	27	24	27	26	30	30	30
Diameter of eye	7	7	7	7	7	8	8	8
Interorbital width	4	5	5	5	5	5	6	6
From eye to nostril	4	5	4	4	5	6	5	6
„ end of snout	9	10	8	9	9	10	10	10
Diameter of tympanum	3·5	4	3·5	3·5	3·5	4	3·5	4
Length of parotoid	15	17	15	16	19	18	13	18
Width of parotoid	7	8	7	11	9	8	9	8
Fore limb	45	51	44	45	45	46	40	53
Hind limb	90	104	87	94	89	93	80	105
Tibia	27	31	26	27	26	27	26	31
Foot	34	36	30	32	31	33	30	38

1. Verona: de Betta.
2. Athens: Smith Woodward.
3. Duirat, Tunisia: Anderson.
4. R. Ili: Lansdell.
5. Berlin: Boulenger.
6. Szamos Ujvar, Hungary: Méhely
7. Ghardaia, Algeria: Lataste.
8. Dead Sea: Tristram.

Skeleton.—The skull is less strongly ossified than in *Bufo vulgaris;* the fronto-parietals, which are a little narrowed in front, meet only in the posterior half, a narrow portion of the endocranial fontanelle being exposed except in very old individuals; these bones are usually separated from the nasals, a part of the upper surface of the ethmoid remaining exposed in front of them; the squamosal is more detached from the prootic.

Fig. 86.



Upper view of skull.

The vertebral column, to the base of the urostyle, measures once and one-fifth to once and one-third the length of the skull in males, once and a half to once and three-fifths in females. The third diapophysis is a little shorter than the second; the sixth, or the sixth and seventh, are directed forwards. The distal diameter of the sacral diapophysis equals its length. Urostyle as long as the six or seven vertebræ preceding it, but slightly longer than the skull, exceptionally with a short transverse process at the base.

Two bones to the pollex, which is much more developed in males than in females. Pelvis as long as the vertebral column without the urostyle. Tibia as long as, or slightly longer than the femur, which is more strongly curved than in *B. vulgaris*, and measures once and two-thirds to once and four-fifths the length of the tarsus.

Other characters as in *B. vulgaris.*

MEASUREMENTS OF SKELETON (in millimetres).

	♂		♀
Length of skull	19	...	17
Width of skull	25	...	23
Least interorbital width	4·5	...	4·5
Dorsal vertebral column	29	...	24
Urostyle	21	...	20
Humerus	23	...	19
Radius-ulna	16	...	12
Manus	20	...	18
Pelvis	32	...	28
Femur	25	...	22
Tibia	24	...	22
Tarsus	15	...	13
Pes	30	...	27

HABITS.—Like its congener *Bufo vulgaris*, *B. viridis* is terrestrial and crepuscular; but, as the breeding season is much more prolonged, lasting from April to the end of June or the middle of July, owing to the different condition of the ovaries in the females, males are found swimming about in the water day and night three months in the year. C. Koch mentions having found spawn near Frankfort-on-the-Main in August, 1871. The green toad jumps and swims well, its movements being more lively than those of the common toad, and very different from those of the natterjack, with which, curiously, this species has been united by some authors, who, no doubt, had never observed the two alive. This toad is often found near the dwellings of man, in small gardens, or on waste ground and heaps of rubbish, even in the suburbs of large cities, as Berlin and Frankfort-on-the-Main, where I have myself come across them in such situations. In some parts of Germany it has received the name "Hausunke," from its abundance in cellars. Young specimens are especially conspicuous, hopping about in broad daylight throughout the summer. The odour of the cutaneous secretion, which is produced very readily and in great abundance, reminds me of a linseed poultice.

The voice of the breeding male is louder than that of the common toad, but much less powerful than that of the natterjack. But for the intensity, it may

be compared to a policeman's whistle, being clear and sonorous with rolling r's.

The male embraces the female under the arms, pressing the hands on the breast as in frogs,—without, however, their ever meeting, as usual in the latter. The embrace may last for a few days. The long egg-strings are produced slowly, and twisted round weeds as in the common toad. The larvæ transform about two months later, the young, on leaving the water, measuring 10 to 17 mm. from snout to vent.

On the island of Lipari, Mr. Norman Douglass found tadpoles abundant in the rivulets of warm mineral water which run down to the sea in the western part of the island, and the late A. Walter observed this toad to resort to wells of brackish water in the Transcaspian steppes.

Eggs.—Resembling those of *B. vulgaris*, but usually smaller, measuring about one and a half millimetres in diameter, and more numerous, forming longer strings, in which they are disposed in files of three or four; when the strings are stretched the eggs are arranged in double files. The number of eggs has been estimated by Héron-Royer at 10,000 to 12,000. The embryo drops out on the third or fourth day, before the appearance of the external gills, which are small, stump-like, and unbranched, and with the tail in a rudimentary condition.

Tadpole (Pl. II, fig. 4).—Intermediate between *B. vulgaris* and *B. calamita*, but larger than either, and with broader internarial space. Mouth wide, as in *B. vulgaris;* labial teeth variable, sometimes as in *B. vulgaris*, sometimes more as in *B. calamita;* the second upper series narrowly or widely interrupted in the middle; first lower series measuring one-half to three-fourths the length of the second.

Distance between the eyes about once and a half the distance between the nostrils, and equal to the width of the mouth. Tail three or four times as long as deep, broadly rounded at one end, its upper crest more

convex than in *B. vulgaris* and a little deeper than the lower; the depth of the muscular part of the tail about half the greatest total depth.

Brown or greyish-olive above, uniform or with small darker spots; belly greyish-white; caudal crests greyish-white, with or without small brown spots or dots.

Total length 44 mm.; body 18 mm.; width of body 13 mm.; tail 26 mm.; depth of tail 9 mm.

Habitat.—This species has a very wide geographical range, but is absent from Western Europe. It inhabits the whole of Central and Southern Europe as far west as the Rhine (from Elberfeld to Mayence) and the Alps, the Balearic and other islands of the Mediterranean, North Africa from Morocco to Lower Egypt, and South-western and Central Asia as far east as Mongolia,* Eastern Turkestan, Afghanistan, and the Himalayas. In Europe it is found in Southern Sweden, Gothland, Denmark, Russia, Germany, with exception of the north-west and extreme south-west, Austria-Hungary, and all the countries east of the Adriatic, Switzerland south of the Alps, the Alps of Savoy near the Italian frontier, and all over Italy. It reaches an altitude of nearly 6500 feet in Savoy, and ascends to 15,000 feet in the Himalaya, the highest point at which a Batrachian has yet been observed.

A female specimen from Turin, received from Count Peracca, is figured on Pl. XI. Variations in the markings are represented on Pl. XII; figs. 1—3, from Cyprus; fig. 4, from Casablanca, Morocco; and fig. 5, from between Quetta and Nushki, Baluchistan.

* There is also an indication of this toad in Manchuria (*Bufo variabilis*, var. *amurensis*, Maack, 'Voy. Amour,' p. 153, 1859), which I suspect to be based on a confusion with *Bufo raddii*, Strauch.

11. Bufo calamita.

(Plate XIII.)

Rösel, Hist. Ran., p. 107, pl. xxiv (1758).

Bufo calamita, Laurenti, Syn. Rept., p. 27, pl. i, fig. 1 (1768); Daudin, Hist. Rain. Gren. Crap., p. 77, pl. xxviii, fig. 1 (1803), and Hist. Rept., viii, p. 153 (1803); Pennant, Brit. Zool., iii, p. 24 (1812); Gravenhorst, Delic. Mus. Vratisl., p. 65 (1829); Bonaparte, Icon. Faun. Ital., Anf. (1838); Bell, Brit. Rept., p. 116, fig. (1839); Nilsson, Skand. Faun., Amf., p. 104 (1842); Günther, Cat. Batr. Sal., p. 57 (1858); Bruch, Würzb. Naturw. Zeitschr., iii, 1862, p. 185; Ward, Intellectual Observer, v, 1864, p. 227, pl. —; Steenstrup, Vidensk. Meddel., 1869, pp. 8 & 20, fig.; Collin, Naturh Tidsskr. (3), vi, 1869, p. 342; Fatio, Vert. Suisse, iii, p. 402 (1872); Koch, Ber. Senck. Ges., 1872, p. 166; Schreiber, Herp. Eur., p. 141 (1875); Lataste, Herp. Gir., p. 291 (1876); Leydig, An. Batr., p. 36 (1877); Boulenger, Proc. Zool. Soc., 1880, p. 547, and Cat. Batr. Ecaud., p. 293 (1882); Héron-Royer, Bull. Soc. Zool. France, 1884, p. 29, and Bull. Soc. Et. Sc. Angers (2), xvi, 1887, p. 122; Greening, Yorkshire Naturalist, 1888, p. 357; Bedriaga, Bull. Soc. Nat. Moscou, 1889, p. 401, and Batr. Rept. Portug., p. 13 (1889); Héron-Royer & Van Bambeke, Arch. Biol., ix, 1889, p. 295; Boulenger, Proc. Zool. Soc., 1891, p. 614, pl. xlvi, fig. 6; Martin & Rollinat, Vert. Dép. Indre, p. 343 (1894); Werner, Rept. Amph. Oesterr.-Ung., p. 100 (1897); Dürigen, Deutschl. Amph., p. 494, pl. i, fig. 3 (1897).

Rana fetidissima, Hermann, Tab. Affin. Anim., p. 260 (1783).

Rana portentosa (Blumenbach), Sturm, Deutschl. Faun., iii, Heft 1 (1797).

Bufo cruciatus, Schneider, Hist. Amph., i, p. 193 (1799).

Rana mephitica, Shaw, Gen. Zool., iii, p. 149, pl. xliii (1802).

Bufo rubeta, Fleming, Brit. Anim., p. 159 (1828).

Bufo portentosus, Schinz, Faun. Helv., p. 144 (1837).

Bufo viridis, part., Duméril & Bibron, Erp. Gén., viii, p. 681 (1841).

Epidalea calamita, Cope, Nat. Hist. Rev., 1865, p. 102.

Head once and one-fourth to once and two-fifths as broad as long; snout short and blunt, with indistinct canthus and slightly concave loreal regions, as long as or a little shorter than the diameter of the orbit; nostrils equally distant from the eyes and the tip of the snout, or a little nearer the former; eyes nearly equally distant from the tip of the snout and the angles of the jaws; interorbital space flat and narrow,

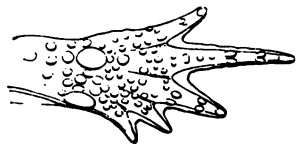
Bufo calamita.

two-thirds to four-fifths the width of the upper eyelid, equal to the space between the nostrils; tympanum rather indistinct, sometimes even quite hidden, usually distinct only in its anterior half, rounded, not measuring more than half the diameter of the eye; cleft of the mouth extending to or hardly beyond the vertical of the posterior corner of the eye.

Fingers short and rather pointed; third longest, fourth shortest, first and second equal; subarticular tubercles small and in pairs; a large flat rounded tubercle in the middle of the hand, and another, smaller and oval, at the base of the inner finger.

Hind limb remarkably short, little longer than head and body in males, not or but slightly longer or even a little shorter than head and body in females and young; the tarso-metatarsal articulation reaches the shoulder or the posterior corner of the eye in males, the axil or the shoulder in females and young; tibia as long as or slightly shorter than the femur, the heels meeting when the limbs are folded at right angles

FIG. 87.



Lower view of foot of male.

to the rhachis. Toes depressed and short, obtusely pointed, at most hardly half webbed, often only connected at the base, the web often not extending as a distinct fringe along the sides; subarticular tubercles small, all or most of them in pairs; two large metatarsal tubercles, that at the base of the inner toe oval and prominent, that at the base of the fourth toe round and flat. A fold is usually present along the inner side of the tarsus; it may, however, be very indistinct, or even absent.

The warts spread on the back large, but not very pro-

minent, flattish, and without any trace of horny spines; the largest distinctly porous to the naked eye; two or three very prominent glands at the angle of the mouth. Parotoids usually rather small, feebly prominent, oval or subtriangular, beginning at a short distance behind the upper eyelids, parallel or slightly converging backwards; their width equals two-fifths to four-fifths their length, which is equal to their distance from the nostrils or less; sometimes width and length are

FIG. 88.

Female, upper view.

nearly equal. A similar gland on the upper surface of the forearm and another on the calf. Lower surfaces covered with rounded granules, which are much more developed and more distant from one another on the lower belly and under the thighs.

Greyish, greenish, brownish, or pinkish above, with green, olive, or brown marblings or numerous spots, very variable in size and shape, their outlines not so well defined as is commonly the case in *Bufo viridis*. The markings generally more distinct from the

ground-colour upon the limbs. Body often dotted all over with black. The large warts on the back often red or reddish, margined with black; parotoids also often reddish, sometimes with a dark border all round; the warts at the angle of the mouth always red. Nearly always a narrow, filiform yellow vertebral line extends along the middle of the back from the snout or the vertex to the vent; it is sometimes interrupted, rarely entirely absent; in addition to this line there is sometimes a broader yellowish vertebral streak. A light wavy lateral stripe is often present, especially in females. Lower surfaces dirty white, more or less abundantly spotted with blackish. Tips of fingers and toes brown or blackish. Iris greenish-yellow, veined or vermiculated with black

Specimens from the Spanish peninsula and the South of France are often more handsomely marbled than is the case in more northern representatives, and as the yellow vertebral line is not infrequently absent, such examples have been referred by some authors to *Bufo viridis*.

Males distinguished by stronger fore limbs, somewhat longer hind limbs, and a large subgular vocal sac, which, when swollen, equals or exceeds the head in size; this sac is most developed during the breeding season, when, from its pigmentation, the male's throat is bluish or violet. The inner finger is not at all thickened, but is covered in spring, or even throughout the year, together with the second and third fingers, with brown or blackish horny excrescences, forming a band on the inner and upper side.

In *Bufo vulgaris* the male is usually considerably smaller than the female; in *B. viridis* the disproportion is less marked, and in this species it can hardly be said to exist, although there is a slight difference between the maximum lengths hitherto recorded in the two sexes, viz. 74 mm. for the male (Brussels) and 80 for the female (Geneva).

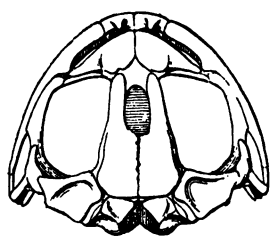
MEASUREMENTS (in millimetres).

	♂			♀		
	1.	2.	3.	4.	5.	6.
From snout to vent	52	64	73	75	72	65
Length of head	14	18	19	17	18	17
Width of head	18	24	26	24	24	23
Diameter of eye	5	7	8	7	6	7
Interorbital width	3	4	5	4	4	4
From eye to nostril	3	3·5	4	4	4	4
„ end of snout	6	9	10	9	9	8
Diameter of tympanum	—	2·5	4	3	3	3
Length of parotoid	9	10	14	12	11	11
Width of parotoid	6	7	12	7	7	8
Fore limb	32	36	45	39	37	34
Hind limb	57	66	83	73	68	62
Tibia	16	21	25	21	20	19
Foot	20	23	29	23	24	20

1. Castlemaine Harbour, Ireland: Robinson.
2. Blackheath.
3. Oporto: Allen.
4. Ostend: Boulenger.
5. Mesnil-St.-Blaise, Belgium: Boulenger.
6. Alemtejo, Portugal: Gadow.

SKELETON.—The skull differs from those of *B. vulgaris* and *B. viridis* in the form of the fronto-parietals, which are only about one-third as broad in front as behind, and embrace a wide fontanelle, and in the zygomatic process of the squamosal being more rudimentary still.

FIG. 89.



Upper view of skull.

The length of the vertebral column, to the base of the urostyle, equals hardly once and one-third or once and a half that of the skull in males, once and two-fifths to once and two-thirds in females. Diapophyses of third vertebra as long as second, of eighth or

seventh and eighth directed slightly forwards; of ninth or sacral strongly dilated, as broad as long or slightly broader. Urostyle as long as the skull. A single bone to the pollex. Pelvis slightly longer than the vertebral column without the urostyle. Tibia as long as or slightly shorter than the femur, which is rather strongly curved, and measures once and three-fifths to once and two-thirds the length of the tarsus.

MEASUREMENTS OF SKELETON (in millimetres).

	♂		♀
Length of skull	16	...	17
Width of skull	18	...	22
Least interorbital width	3	...	4
Dorsal vertebral column	21	...	24
Urostyle	16	...	17
Humerus	18	.	18
Radius-ulna	12	...	12
Manus	15	...	18
Pelvis	24	...	27
Femur	19	...	20
Tibia	18	...	20
Tarsus	12	...	12
Pes	24	...	22

HABITS.—This lively little toad, known by the Anglo-Saxon name "Natter-Jack," differs from all other European Batrachians in being unable to hop, owing to its remarkably short hind limbs. It supplies the deficiency by running at a considerable pace, the body raised from the ground, but stopping every few seconds. It is a good burrower in sandy localities, for which it shows a decided predilection, although in France and Spain, where it is very generally distributed and in many places the commoner species of *Bufo*, it accommodates itself to every kind of soil, requiring less moisture than any other Batrachian. In Northern Europe it is particularly abundant in the sand-hills close to the sea, where in summer adult as well as young may be seen crawling or running about in full sunshine among the sparse tufts of marram grass, whilst the eggs and larvæ are developing in neighbouring pools of strongly brackish water.

The breeding period is a much protracted one, although beginning later than that of any other species, the edible frog excepted; for it may last until July or August, or even September, as observed by Arthur de l'Isle in Brittany. In Belgium I found the species breeding in the end of April, in May, and in June; in France as early as the beginning of April and as late as July and the first days of August. On the coast of Cheshire, Mr. L. Greening has observed the oviposition at the end of May and early in June, and the British Museum has received from the Warrington Museum a specimen from Southport, Lancashire, labelled as having spawned on April 24th, 1889. In Germany it is said to spawn from the middle of April to the end of June. The season seems to be at its height between the beginning of May and the middle of June.

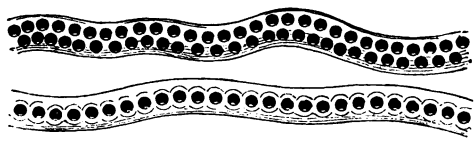
Bufo calamita is a bad swimmer, and usually resorts to the water only at night, not venturing far from the borders; pairs are found in embrace in the daytime in holes on the banks of ponds or among reeds (hence the name *calamita*, from *calamus*, reed), where they betray their presence through their very loud croak, *ra*, *ra*, *ra*, consisting of a single vibrating note. Choruses, audible at a distance of a mile or more, are produced after sunset. The male, when clasping the female, digs the closed fists into the axils, like the common toad, but the embrace is of much shorter duration, the eggs being laid in a few hours during the night. If there are reeds or other weeds about, the egg-strings are twined round them; if not—for this toad often spawns in small puddles without vegetation, or in roadside ditches—the paired strings are simply stretched along the clay or sand at the bottom, where they resemble, as Héron-Royer observes, a diminutive railway. The evolution is rapid, and the young usually quit the water five to eight weeks after the eggs have been deposited, measuring only 7 to 10 mm. from snout to vent. In Hardwicke's 'Science Gossip' for 1872,

p. 70, Mr. W. H. Warner reports having seen, on Nov. 8th, near Abingdon, Berks, in the pools of a deep quarry frequented by the natterjacks, tadpoles in a half-torpid state, some with and some without legs. These tadpoles were no doubt remains of an exceptionally late brood, and very likely did not transform until the following spring. Males are much more abundant than females.

When molested, *Bufo calamita* emits a very strong and unpleasant odour, produced by the secretion from the dermal glands, to which it owes the denominations of *fœtidissimus* and *mephiticus* recorded in the synonymy. It is difficult to convey an exact idea of this smell: boiled india-rubber is perhaps a better comparison than that of Rösel—"something between ignited gunpowder and a Dutch clay pipe smoked for the first time;" there is certainly nothing sulphury about it, in spite of a statement of Lord Clermont's.

Eggs.—Small, black, with a small grey or whitish lower pole, measuring about 1½ millimetres in diameter, in two mucilaginous strings 3 or 4 millimetres in diameter, which are shorter than in *B. vulgaris*.

Fig. 90.



These strings measure only 5 or 6 feet, when unstretched, and contain 3000 to 4000 eggs, which are in two files, in one when stretched. The evolution is rapid; the embryo is liberated after three to five days, and produces a few days later its rudimentary, unbranched external gills, which do not last much more than a day. Héron-Royer has described the changes in their disposition which the eggs undergo during development. At first in two files they become displaced as they enlarge, and form a single row; the

strings, unlike those of *B. vulgaris*, lose their cylindrical form two or three days after being laid, each inner capsule swelling up, and ultimately assume a rosary-like appearance.

Tadpole (Pl. II, fig. 5).—Differs from that of the common toad in the narrower mouth, which measures less than the interocular space and a little more than the distance between the nostrils; the somewhat more convex upper caudal crest; and the lesser length of the second series of upper labial teeth, which is very broadly interrupted in the middle.

Black above, sides and belly dark lead-grey, with pale bronzy dots; caudal crests grey, finely speckled with black; throat and chin sometimes whitish; the light vertebral line, characteristic of this species, sometimes present before the appearance of the fore limbs.

This is the smallest European tadpole, seldom reaching the length of 30 millimetres recorded by Bedriaga. The following are the measurements of the largest of hundreds of specimens examined by me. Total length, 25 millimetres; body, 10; width of body, 7; tail, 15; depth of tail, 5.

Habitat.—The natterjack is a Western species, abundant and generally distributed in France and the Spanish Peninsula, becoming gradually more local to the east, where it occurs in company with *Bufo viridis*, and not extending further than the Gulf of Riga, Poland, Bohemia, and Galicia;* it is absent south of the Alps and in the islands of the Mediterranean. In the north it is found in Ireland, in Scotland on the Moray Firth, in England, in Denmark, in Southern Sweden, and in the islands of the Baltic. Its distribution in England is an irregular one, the species being more local than rare, and apparently restricted to sandy localities; it is on record from Middlesex, Kent, Surrey, Hampshire, Dorsetshire, Devonshire, Cornwall, Hert-

* The record of *B. calamita* in Amourland is probably due to a confusion with examples of *B. vulgaris* showing a light line along the spine.

fordshire, Berkshire, Cambridgeshire, Suffolk, Norfolk, Lincolnshire, Cheshire, Lancashire, Westmorland, and Cumberland. In Ireland it is only known from the co. Kerry, where it is very abundant around Castlemaine and Valentia harbours. The highest altitudes at which this species has been found are 3250 feet in the Alps, and 4000 feet in the Jura.

In describing the distribution of the common toad, attention has been drawn to its absence from many islands. The present species and the green toad, on the contrary, appear to be found in most of the islands within the area of their habitat, a fact that may bear relation to the greater facility with which the eggs and larvæ of both these species can resist salt water.

Two specimens, male and female, from Mesnil-Saint-Blaise, Belgium, are figured on Pl. XIII, the male in the act of croaking, with fully distended gular sac, the female in the running attitude so characteristic of this species.

Hybrids.—Although no specimens have yet been found in a free state which there is sufficient reason to pronounce as hybrids, it is a well-known fact, tested by de l'Isle, Bruch, Pflüger, Born, and Héron-Royer, that under artificial fecundation our species of toads cross much more readily than do the frogs. De l'Isle succeeded in obtaining hybrid larvæ between *Bufo vulgaris* and *B. calamita*, Héron-Royer perfect young of the same, and Born perfect young between *B. vulgaris* and *B. viridis*. C. Koch has noticed, under the name of *Bufo cinereus*, var. *hybridus*, a female specimen caught near Frankfort (M.) in April, 1872, pairing with a *B. viridis*, and which he assumed, from its general appearance, to be a cross between *B. vulgaris* and *B. viridis*. The description given of the specimen is, however, to my mind, by no means convincing as to its hybrid nature.

Family 4.—HYLIDÆ.

Vertebræ procœlous, without autogenous ribs; diapophyses of sacral vertebra dilated. Upper jaw toothed. Terminal phalanges claw-shaped, swollen at the base.

The arboreal frogs which constitute this family are nearly related to the toads, from which they differ in the presence of teeth in the upper jaw, and in the shape of the terminal phalanges, supporting adhesive disks of a special nature,* by which they are enabled to climb with great facility. The *Hylidæ* embrace thirteen genera, and nearly equal the *Ranidæ* in the large number of the species. They are absent from tropical and South Africa and Madagascar, and from the greater part of the Indian region. As regards the number of species, they are few in the Palæarctic region, more numerous in North America, and most abundantly represented in Central and South America and Australia. The type genus is the only European representative.

7. HYLA.

Laurenti, Syn. Rept., p. 32 (1868).—Partim.

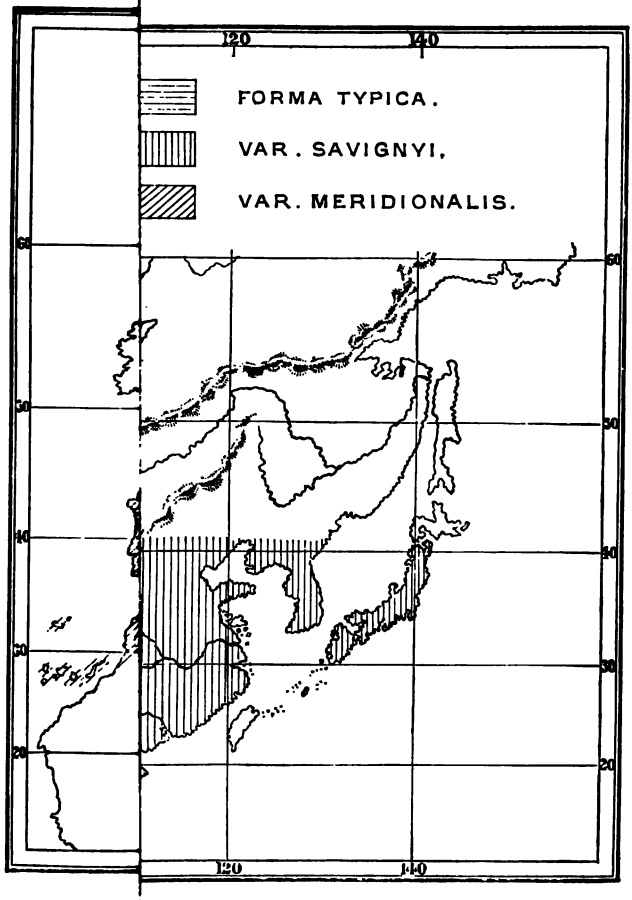
Pupil horizontal. Tongue entire or slightly nicked, more or less free behind. Vomerine teeth. Tympanum distinct or hidden. Fingers free or webbed; toes webbed; tips of fingers and toes dilated into distinct disks; outer metatarsals bound together. Omosternum and sternum cartilaginous.

About 160 species are known.

The distribution of the single European species and its varieties over nearly the whole of the Palæarctic region is shown in the accompanying map.

* Described above, p. 15.

[*At page* 246.


120
140
FORMA TYPICA.
VAR. SAVIGNYI.
VAR. MERIDIONALIS.
60
50
40
30
20
120
140

Hyla arborea.
Forma typica. Var. meridionalis.

12. HYLA ARBOREA.

(Plates XIV and XV.)

Rösel, Hist. Ran., p. 32, pls. ix—xii (1758).

Rana arborea, Linnæus, Faun. Suec., 2nd ed., p. 102 (1761), and Syst. Nat., i, p. 357 (1766); Sturm, Deutschl. Faun., iii, Heft 1 (1799); Seetzen, Reise Syr. Pal., iii, p. 486 (1855).

Hyla viridis, Laurenti, Syn. Rept., p. 33 (1768); Daudin, Hist. Rain. Gren. Crap., p. 14, pl. i (1803), and Hist. Rept., viii, p. 23 (1803); Gravenhorst, Delic. Mus. Vratisl., p. 23 (1829); Duvernoy, Règne Anim., Rept., pl. xxxvii, fig. 3 (1836); Bonaparte, Icon. Faun. Ital., Rett. Anf. (1837); Nilsson, Skand. Faun., Amf., p. 73 (1842); Duméril & Bibron, Erp. Gén., viii, p. 581 (1841); Fatio, Vert. Suisse, iii, p. 423 (1872); Lataste, Herp. Gir., p. 214 (1876); Lessona, Atti Acc. Linc., i, Mem. Cl. Sc. fis., 1877, p. 1090, pl. iii; Martin & Rollinat, Vert. Dép. Indre, p. 318 (1894).

Calamita arboreus, Schneider, Hist. Amph., i, p. 153 (1799); Merrem, Tent. Syst. Amph., p. 170 (1820).

Hyla arborea, Cuvier, Règne Anim., ii, p. 94 (1817); Schlegel, Faun. Japon., Rept., p. 112, pl. iii, fig. 6 (1836); Günther, Cat. Batr. Sal., p. 107 (1858); Collin, Naturh. Tidsskr. (3), vi, 1869, p. 302; De Betta, Faun. Ital., Rett. Anf., p. 61 (1874); Schreiber, Herp. Eur., p. 106 (1875); Leydig, An. Batr., p. 94 (1877); Boulenger, Cat. Batr. Ecaud., p. 379 (1882); Camerano, Mem. Acc. Torin. (2), xxxv, 1883, p. 223, fig.; Héron-Royer, Bull. Soc. Et. Sc. Angers, xiv, 1885, p. 102; Héron-Royer & Van Bambeke, Arch. Biol., ix, 1889, p. 245; Bedriaga, Bull. Soc. Nat. Mosc., 1889, p. 466, and Amph. Rept. Portug., p. 16 (1889); Héron-Royer, Mém. Soc. Zool. France, iv, 1891, p. 75; Boulenger, Proc. Zool. Soc., 1891, p. 610, pl. xlvi, figs. 1—3; Méhely, Mon. Kronstadt, Herp., p. 72 (1892); Werner, Rept. Amph. Oesterr.-Ung., p. 101 (1897); Dürigen, Deutschl. Amph., p. 507, pl. iv, fig. 3 (1897).

Hyla savignyi, Andouin, Descr. Egypte, Rept., Suppl., p. 183, pl. ii, fig. 13 (1827).

Dendrohyas arborea, Tschudi, Class. Batr., p. 74 (1838).

Dendrohyas sarda (Bonelli), De Betta, Cat. Syst. Rer. Nat., Rept., p. 24 (1853).

Hyla arborea, var. *japonica*, Günther, l. c., p. 109; Boulenger, Cat. Batr. Ecaud., p. 381, and Proc. Zool. Soc., 1887, pl. li, fig. 2.

Hyla arborea, var. *meridionalis*, Boettger, Abh. Senck. Ges., ix, 1874, p. 66; Boulenger, Cat., p. 380, and Tr. Zool. Soc., xiii, 1891, p. 159; Steindachner, Ann. Hofmus. Wien, vi, 1891, p. 303.

Hyla japonica, Camerano, Atti Acc. Torin., xiv, 1879, p. 895.

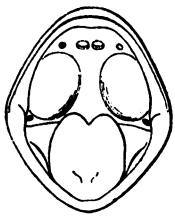
Hyla perezi, Boscá, An. Soc. Esp., ix, 1880, p. 181, and x, 1881, pl. ii, figs. 7—10.

Hyla viridis, var. *sarda*, Boettger, Ber. Senck. Ges., 1880-81, p. 143.

Hyla arborea, var. *savignyi*, Boulenger, Cat., p. 380; Camerano, Mem. Acc. Torin. (2), xxxv, 1883, p. 226, fig., and Boll. Mus. Torin., viii, 1893, No. 162, p. 4.
Hyla arborea, var. *intermedia*, Boulenger, l. c., p. 381.
Hyla barytonus, Héron-Royer, Bull. Soc. Zool. France, 1884, p. 220, pl. ix, and Bull. Soc. Et. Sc. Angers, xiv, 1885, p. 104.
Hyla arborea, var. *orientalis*, Bedriaga, Bull. Soc. Nat. Mosc., 1889, p. 473.
Hyla arborea, var. *molleri*, Bedriaga, l. c., p. 474.

Vomerine teeth in two small, round or transversely oval groups between the choanæ, which are not larger than the Eustachian tubes. Tongue circular, moderately free and nicked behind.

FIG. 91.



Open mouth.

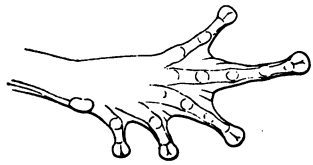
Head broader than long; snout short, rounded, scarcely projecting, as long as the diameter of the orbit; canthus rostralis distinct; loreal region slightly oblique, grooved; nostril midway between the eye and the tip of the snout, or a little nearer the latter; eye moderate; interorbital space as broad as the upper eyelid, a little broader than the distance between the nostrils; tympanum perfectly distinct, not more than half the diameter of the eye.

Fingers moderate, webbed at the base, the rudimentary web sometimes very indistinct, the terminal disks nearly as large as the tympanum; first finger shorter than second, second and fourth nearly equal, third longest; subarticular tubercles large, prominent; no distinct palmar tubercles. A strong fold separates the hand from the forearm above.

Hind limb moderate; the tibio-tarsal articulation reaches the tympanum, the eye, or between the eye and the nostril; tibia as long as or a little longer than the femur, the heels nearly meeting or overlapping when the legs are folded at right angles to the rhachis. Foot as long as or shorter than the tibia; toes one-half to two-thirds webbed, the disks a little smaller than those of the fingers; subarticular tubercles well developed, prominent; a round or oval inner metatarsal tubercle, measuring one-third to two-fifths the

length of the inner toe; outer metatarsal tubercle very small or indistinct. A more or less distinct fold along the inner edge of the tarsus.

FIG. 92.

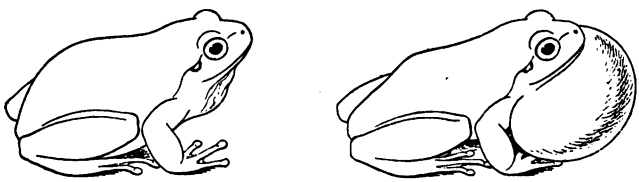


Lower surface of foot.

Skin perfectly smooth above, granular on the belly and under the thighs, also on the throat in the female; a fold above the tympanum, and another across the breast.

Usually uniform bright green above, but turning to grey, yellowish, or blackish, with or without small darker spots; white beneath; inner fingers and inner toes pale yellow or rosy. The markings which distinguish the different varieties will be noticed further on. Iris golden, more or less obscured by brown vermiculations, or nearly entirely of a rather dark brown.

FIG. 93.



Male before and after inflation of the vocal sac.

Male distinguished by a large external subgular vocal sac, of yellow, brown, or green colour, which when empty forms folds, and when blown out resembles a bladder considerably larger than the head. Apparent copulatory asperities are absent, but the base of the inner finger is sometimes covered during the breeding season with small, colourless, horny granules.

GEOGRAPHICAL VARIATIONS.—This species may be divided, from the permanent markings, into a number of more or less defined varieties, each of which has a distinct habitat.

1. *Forma typica.* A greyish, brown, or black streak, edged above with yellow or white, extends from the nostril through the eye and the tympanum along the side of the body, sending upwards and forwards a branch on the loin; a whitish line on the upper lip, descending to the shoulder, and then ascending to the eye, limiting an elongate green area behind and below the commissure of the jaws; a dark, light-edged cross-line above the vent; the outer side of the fore-arm, carpus and fourth finger, tibia, tarsus, metatarsus, and fifth toe with a more or less distinct dark and light edge.

This is the most widely distributed form in Europe, inhabiting the greater part of the continent and extending into Asia Minor.

2. Var. *savignyi*, Aud. (*japonica*, Gthr.). Similar to the typical form, but the marking on the loin is absent, or distinct from the lateral streak, which is frequently broken up into spots from the middle of the side.

Inhabits Corsica, Elba, Sardinia, the Greek Archipelago, South-western Asia, Lower Egypt, Corea, China, and Japan.

Allusion has been made in the Introduction to the great facility with which the common tree-frog not only changes colour, but also puts on temporary dark or light spots, which greatly alter its appearance. In this variety, however, we find specimens with large dark spots or stripes on the back and cross-bars on the limbs, which appear to be permanent, and owing to which these frogs have been regarded as distinct species (*H. japonica*, Gthr., *H. sarda*, Bonelli). Such specimens are more frequent in China and Japan, but also occur, though in lesser abundance than and promiscuously with unspotted ones, in Corsica, in

1.

6.

2.

3.

4.

5.

Hyla arborea, var. savignyi.

Sardinia, in Cyprus, in Syria, and in Persia. We have here to deal with a case of colour-dimorphism which is the more striking from the fact that in most parts of Europe the coloration of the tree-frog, apart from the play of the chromatophores, is so very constant.

These spotted or striped examples are of further interest in throwing light upon the origin of the curious lumbar marking of the typical form. Elongate, dark, light-edged spots may form a regular series along each side of the back, the last spot meeting at an angle the lateral dark streak, with which it may even sometimes be almost confluent, as is shown on one side in a Sardinian specimen in M. Lataste's collection (Pl. XV, fig. 1), and in a Japanese specimen in the British Museum (fig. 5). There is every reason to believe that these examples represent the original form from which the other colour-varieties have been derived, and that the lumbar marking of the typical *H. arborea* is to be looked upon as the remains of a second, upper longitudinal stripe.

Some specimens (Cyprus) have four stripes or series of spots in addition to the lateral; others (Japan) have a pair of ⌟- or >-shaped markings on the scapular region.

3. Var. *intermedia*, Blgr. Agrees with the typical form in having a lateral line and a mark on the loin; but the green extends on the sides of the throat, as in var. *meridionalis*. This variety was established on a specimen from Bologna and another from Sicily, which are perhaps only mongrels between the typical form and the var. *meridionalis*.

4. Var. *meridionalis*, Bttgr. (*perezi*, Boscá, *barytonus*, Héron-Royer). The green of the upper surfaces extends on each side of the throat, where it gradually vanishes, or involves nearly the whole of the vocal sac; a dark brown or golden line from the nostril to the eye, usually continued behind the latter, covering entirely or partially the tympanum; no

lateral line on the body; a whitish cross-streak above the vent; a whitish or pale golden line along the inner edge of the tibia and the outer edge of the tarsus, metatarsus, and fifth toe; back of the thighs often yellow or pale orange, uniform or speckled with brown. This form inhabits the south of France, Italy, the Pyrenean peninsula, the Balearic Islands, North-west Africa, Madeira, and the Canary Islands.

A further variety (*immaculata*, Bttgr.*) has been described from China, but as it lacks the web between the fingers it cannot be united with *H. arborea*. Var. *orientalis*, Bedr., from Russia, and var. *molleri*, Bedr., from Portugal, I would regard as not sufficiently distinguished from the typical form; and the var. *intermedia*, Blgr., may be merely a mongrel. I shall therefore limit myself to remarks on the value of the characters of the vars. *savignyi* and *meridionalis*, which have been regarded by some authors as distinct species. But before doing this it is desirable to give detailed measurements of specimens of the typical form and the two principal varieties.

MEASUREMENTS (in millimetres).

Forma *typica*.

	♂			♀		
	1.	2.	3.	4.	5.	6.
From snout to vent	44	42	36	44	43	45
Length of head	12	12	11	12	12	12
Width of head	15	15	13	15	15	15
Diameter of eye	4·5	4·5	3·5	4	4·5	4·5
Interorbital width	3·5	4	3	3·5	3·5	3·5
From eye to nostril	3	3	2·5	3	3	3
„ end of snout	6	6	5	6	6	6
Diameter of tympanum	2	2	1·5	2	2·5	2
Fore limb	26	25	21	26	27	27
Hind limb	60	61	53	63	65	63
Tibia	19	19	16	20	19	19
Foot	19	18	15	18	19	19

1. St. Malo: Boulenger.
2, 4. Calabria: Giglioli.
3. Corunna: Seoane.
5. Oporto.
6. Crete: Maltzan.

* Ber. Senck. Ges., 1888, p. 189, and 1894, p. 140.

Var. *savignyi*.

	♂			♀		
	1.	2.	3.	4.	5.	6.
From snout to vent	30	44	40	39	50	39
Length of head	9	12	11	10	13	11
Width of head	11	15	13	13	16	13
Diameter of eye	3·5	4	4	3·5	5	4
Interorbital width	3	4	3·5	3	4	3·5
From eye to nostril	2·5	3·5	3	2·5	3	2·5
„ end of snout	4	6	5	5	6	5
Diameter of tympanum	1·5	2	2	2	2·5	2
Fore limb	18	28	25	26	30	24
Hind limb	45	69	59	59	66	55
Tibia	14	21	19	18	20	16
Foot	12	19	16	16	19	16

1. Elba: Trevelyan.
2. Wady-el-Kurm: Tristram.
3. L. Bamas: Barrois.
4. Sardinia: Lataste.
5. Fao, Persia: Cumming.
6. Gensan, Corea: Leech.

Var. *meridionalis*.

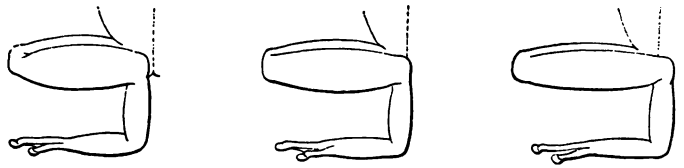
	♂			♀		
	1.	2.	3.	4.	5.	6.
From snout to vent	38	41	43	38	46	48
Length of head	11	11	12	11	12	12
Width of head	13	13	14	12	15	15
Diameter of eye	4	4	4·5	3·5	4·5	4·5
Interorbital width	3	3·5	4	3	3·5	3·5
From eye to nostril	3	3	3	3	3·5	3·5
„ end of snout	5	5	6	5	6	6
Diameter of tympanum	2	2	2·5	2	2·5	2·5
Fore limb	23	25	28	22	26	27
Hind limb	60	65	68	58	69	70
Tibia	19	21	21	18	21	22
Foot	16	17	19	15	19	19

1, 4. Cadillac, Gironde: Lataste.
2. Bologna: Bianconi.
3. Cabeza del Buzy: Boscá.
5. Genoa: Poulton.
6. Hammam Meskoutine: Anderson.

In the typical form the tibia is not longer than the thigh, not or but slightly longer than the foot; when the limbs are folded, the heels hardly or just meet without overlapping, and when stretched forwards the heel or tibio-tarsal articulation reaches the tympanum or the eye. In the var. *savignyi* the proportions are the same, or approach those of the var. *meridionalis*, as, for instance, in the specimen from Elba. In the var. *meridionalis* the form is more slender; the tibia is longer than the femur, longer than the foot,

the heels overlap, and the tibio-tarsal articulation reaches the eye or between the eye and the nostril. Besides, the vocal sac is larger, and the voice deeper, whence the name *barytonus*, which has been given to it by Héron-Royer.

FIG. 94.



Hind limbs of *Hyla arborea*, showing variations in the proportions of the tibia and foot. The dotted line indicates the middle line of the body. A. ♂, *f. typica*, St. Malo. B. ♂, v. *Savignyi*, Jerusalem. C. ♂, v. *meridionalis*, Cannes.

These structural differences are, however, far from constant; there are intermediate forms, as, for instance, the var. *molleri*, which Bedriaga defines as a *H. meridionalis* with the coloration of the typical form. A male specimen from Ciudad Real may, I think, be referred to it; the heels slightly overlap, the tibia measures 17 mm. and the foot 15, just as in a *H. meridionalis*, but the coloration is that of the typical form, and the specimen was identified as such by Boscá. A female from Coimbra, received from Dr. de Bedriaga himself, agrees in the proportion of the limbs: tibia 22 mm., foot 20.

A glance at the preceding tables of measurements suffices to show that the difference in length between tibia and foot, so considerable in the extremes, is bridged over in such a manner as to render a precise definition impossible. The same may be said of the development of the vocal sac. We have therefore to fall back upon the coloration for diagnosing the three forms, and this is surely not enough to justify their being treated as species, the more so as the var. *savignyi* is itself a connecting link between the typical

form and the var. *meridionalis*.* We have here to deal with a similar case as offered by *Rana esculenta*, and I have adopted the same course, viz. reduced the various forms to the rank of varieties.

Skeleton. — Skull feebly ossified. A very large fontanelle above, bordered on the sides by the narrow fronto-parietal bones; ethmoid short, its upper lamina obtusely pointed or rounded in front and penetrating between the nasals, which are small and separated from each other. Squamosal feeble, with short zygomatic branch. Vomers small, separated or narrowly in contact on the median line; palatines well developed; pterygoid small, the three branches about equal in length, and widely separated from the palatine; parasphenoid ⊥-shaped, pointed in front, reaching to between the palatines. Mento-Meckelian bones distinct.

Hyoid a short cartilaginous plate, much broader than long, with moderately slender cornua and no anterior processes, very short postero-lateral processes, and long, slender bony styles (thyrohyals) posteriorly.

Vertebral column twice to twice and one-third as long as the skull. First diapophysis slender and horizontal or directed slightly forwards; second much longer and expanded at the end, somewhat similar in shape to the sacral diapophysis; third to eighth slender and subequal in length; the third and fourth directed backwards, the fifth horizontal, the sixth and seventh directed forwards. Sacral vertebra with moderately dilated diapophyses, and two condyles for articulation with urostyle. Latter a little shorter than the rest of the vertebral column, without transverse processes at the base.

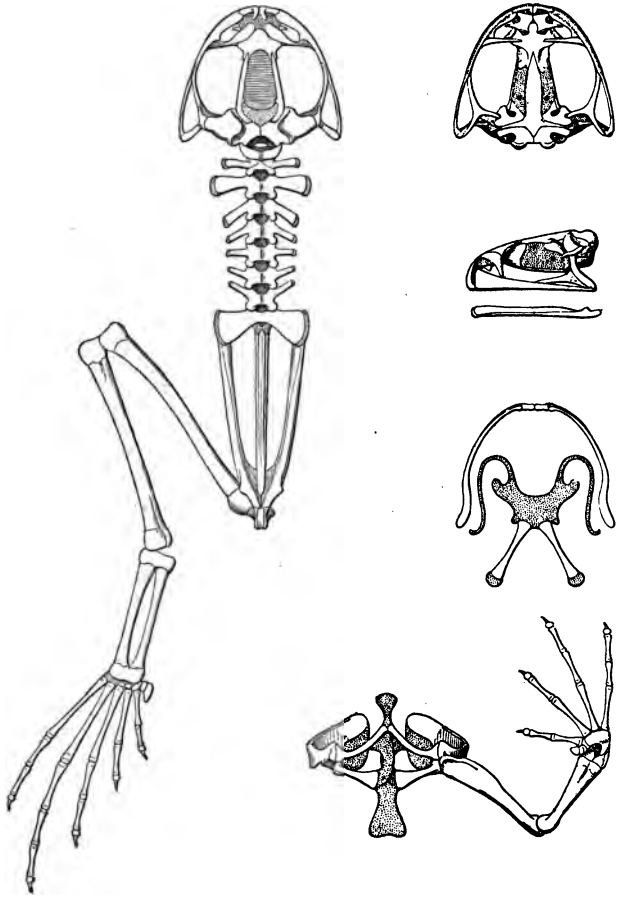
Præcoracoids slender, strongly curved, entering the glenoid cavity; coracoids nearly straight, dilated towards the epicoracoid; omosternum and sternum cartilaginous; supra-scapula partially ossified. Humerus

* I have specimens of the latter from Tangier which show a slight but distinct indication of the lateral streak, and are thus intermediate between *H. meridionalis* and *H. savignyi*.

once and a half as long as radius-ulna. Carpus with six elements, two of which are in contact with radius-ulna; two bones to the præpollex.

Pelvis about two-thirds the length of the vertebral column. Pubis ossified, not entering the acetabulum.

FIG. 95.



Skeleton of male.

Femur feebly curved, as long as or shorter than tibia-fibula; astragalus and calcaneum slender, about half the length of tibia-fibula; three tarsalia in the distal

row, and two bones to the præhallux. Terminal phalanges claw-shaped, swollen at the base.

MEASUREMENTS OF SKELETON (in millimetres).

	F. *typica*.		V. *savignyi*.	V. *meridion*.
	♂	♀	♂	♂
Length of skull	13	13	11	12
Width of skull	16	16	14	15
Least interorbital width	4	4	3·5	4
Dorsal vertebral column	16	16	14	16
Urostyle	15	13	13	14
Humerus	12	11	11	11
Radius-ulna	8	7	6·5	7·5
Manus	15	14	13	13
Pelvis	19	18	17	19
Femur	19	19	18	20
Tibia	19	18	19	21
Tarsus	11	11	10	12
Pes	20	19	17	20

HABITS.— *Hyla arborea* holds a unique position among European Batrachians from its scansorial, arboreal habits. The adhesive disks in which its digits terminate enable it to climb with the greatest facility up smooth vertical surfaces, and a considerable part of its existence is spent in the foliage of bushes and trees. Owing probably to confidence in its protective coloration, this Batrachian makes no attempt to escape when detected, and, although a powerful jumper and expert acrobat, its attitude when handled is so quiet and passive as to make it a pet in all countries: alone of its tribe it does not inspire fright or repulsion to most people, although the acrid secretion of its skin is highly poisonous, and produces a smarting sensation when applied to our mucous membranes or to excoriated parts of our fingers.

Its barometrical qualities, so valued in Germany, where the little frog is kept in glass cylinders furnished with a ladder standing in an inch or two of water, which ladder the frog is supposed to ascend or descend, and thus forecast the weather, have been much exaggerated. Lendenfeld's experiments have convinced him that no reliance can be placed on its

prognostics—a conclusion which my own experience can only confirm.

The tree-frog lives well in confinement, feeding readily on flies and mealworms; a man of the name of Papst, in Gotha, is said to have kept one for twenty-two years.

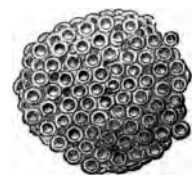
In Central Europe pairing takes place in April or beginning of May, mostly at night, and lasts but a short time. The male seizes the female about the arms, and digs the hands in the axils or above the shoulders under the fold prolonged from the supra-tympanic. The croaking during the pairing season is very loud, produced mostly in the evening and at night, and the males joining in choruses, the rolling *crak-crak* voice is to be heard miles off. These concerts are continued far into the summer when the weather is bright or on the approach of a thunderstorm, and sometimes even as late as autumn. The female enters the water, where she is awaited by the males, only when ready to spawn, and oviposition is accomplished in a few hours. Deep pools or ponds of clear water, more or less richly endowed with vegetation, sometimes flooded quarries, are selected for the purpose, and in the early part of summer the graceful tadpoles may be seen swimming about like fish in every direction, very unlike most others, which keep more to the bottom and only rise now and then to fetch air at the surface, or lazily lie basking in the sun in the shallow parts.

Metamorphosis takes place at the end of July or beginning of August, when swarms of baby tree-frogs may be found hidden in the grass near their birth-place, whence they emerge after a heavy rain in such numbers as to produce the delusion of showers of frogs; a delusion which is much increased by the fact that they sometimes climb up the clothes of passers by, who fancy they have come down on them with the rain.

A case of hibernation in the larval state has been recorded by Lessona.

Eggs.—Deposited in several lumps, not exceeding the size of a walnut, attached to weeds below the surface of the water. Vitelline sphere measuring 1½ mm. in diameter, yellowish-white with grey or pale brown upper pole; external adhesive envelop not measuring more than 4 mm. in diameter. Each female produces only 800 to 1000 eggs. The embryo, when liberated, is yellowish, with rudimentary branched external gills, and a well-developed tail.

Fig. 96.



Tadpole (Pl. II, figs. 6—8).—Length of body once and one-third to once and a half its width, about half the length of the tail. Nostrils a little nearer the eyes than the end of the snout. Eyes perfectly lateral, visible from above and from below, a little nearer the spiraculum than the end of the snout; the distance between the eyes once and a half to twice as great as the distance between the nostrils, which equals the width of the mouth. Spiraculum on the left side, directed upwards and backwards, nearer the posterior than the anterior extremity of the body, not very prominent, but visible from above and from below. Anus opening on the right side, close to the body, above the lower edge of the tail. Tail once and three-fourths to twice and one-third the length of the body, twice to twice and a half as long as deep, acutely pointed, attenuate or mucronate at the end; upper crest very convex, and extending far forwards on the back, almost to between the eyes; lower crest as much developed as the upper, and extending on to the belly considerably beyond the anus; the depth of the muscular portion at its base one-third or rather less than one-third the greatest total depth.

Beak broadly edged with black. Lips bordered with papillæ, which are absent in the middle of the upper border, and usually form two rows on the lower lip. Series of labial teeth $\frac{2}{3}$, all except the first lower

occupying nearly the whole width of the lip; the second upper is narrowly interrupted in the middle, and so is sometimes the third lower; the first lower series only one-third to half as long as the second.

The lines of muciferous crypts can usually be traced without much difficulty: a loop-shaped one on each side of the head, passing above the nostril and bordering the eye above and below, both ends nearly meeting close to the upper lip; and another along each side of the body to the middle of the muscular portion of the tail.

Olive above, with golden gloss; sides with golden spots; belly white, with pearl-coloured or golden spots; muscular part of the tail yellowish with or without blackish dots and frequently with a median black line at its base; caudal crests whitish, immaculate or more or less profusely dotted and spotted with grey or blackish.

Total length 49 mm.; body 16; width of body 12; tail 33; depth of tail 15.

Tadpoles of the var. *meridionalis* differ in having the second series of upper labial teeth more broadly interrupted in the middle, and in having the muscular part of the tail bordered above and below by a black line; these two lines, together with a third running along the middle line of the side of the tail, which is immaculate or but scantily spotted, give it a peculiar appearance.

Camerano has described tadpoles of the var. *savignyi* from Syria. He finds them to agree with the typical form in the buccal apparatus. Some specimens resemble the var. *meridionalis* in the two black lines on the muscular part of the tail, whilst others are quite similar to the typical form. The single Syrian tadpole examined by me is distinguished by a pair of broad dark brown stripes along the muscular part of the tail, the lower being broken up into elongate spots. Thus, as a larva as well as in the perfect state, the var. *savignyi* connects the characters of the typical form

and the var. *meridionalis*, and affords a further argument against specific distinction.

HABITAT.—The range of *Hyla arborea* extends across the Palæarctic region, from Western Europe, Northwest Africa, Madeira, and the Canary Islands to Corea, Japan, China, and Hainan. The northernmost points of its habitat are Southern Sweden and Livonia, and it is absent from the British Isles. The typical form is distributed over the greater part of Europe, with the exception of Southern France, and occurs also in Transcaucasia and Asia Minor. The var. *intermedia* is only known from Italy and Sicily. The var. *savignyi* is found in Corsica, Elba, Sardinia, Asia Minor, Cyprus, Syria, Lower Egypt, Mesopotamia, Persia, Central Asia, Corea, China, Japan, and Hainan. The var. *meridionalis* inhabits the south of France, Spain and Portugal, Liguria, Emilia, Sicily (?), Tunisia, Algeria, Morocco, Madeira, and the Canary Islands.

The typical form reaches an altitude of 3300 feet in the Alps, according to Fatio.

Of the three specimens figured on Pl. XIV, two, male and female, belong to the typical form from Belgium; the third, on the right-hand side, is a female of the var. *meridionalis* from the Riviera.

Specimens of the var. *savignyi* are represented on Pl. XV, figs. 1 and 2, from Sardinia (Lataste Collection); fig. 3, from Cyprus (Rolle); fig. 4, from Wady el Kurm, Syria (Tristram); fig. 5, from Tsu-Shima, Japan (Holst); fig. 6, from Daibutz, Japan (J. Anderson).

Series B.—FIRMISTERNIA.

Pectoral arch immoveable, the coracoids firmly united by a simple epicoracoid cartilage; præcoracoids resting with their distal extremity upon the coracoids, or connected with the latter by the epicoracoid cartilage.

Family 5.—RANIDÆ.

Vertebræ procœlous, without autogenous ribs; diapophyses of sacral vertebra cylindrical. Upper jaw toothed.

This family, the most specialised of the order, contains a large number of genera, and its distribution extends over the greater part of the world, Australia, New Zealand, and the southern parts of South America excepted. The genus *Rana* is its only representative in the western Palæarctic sub-region.

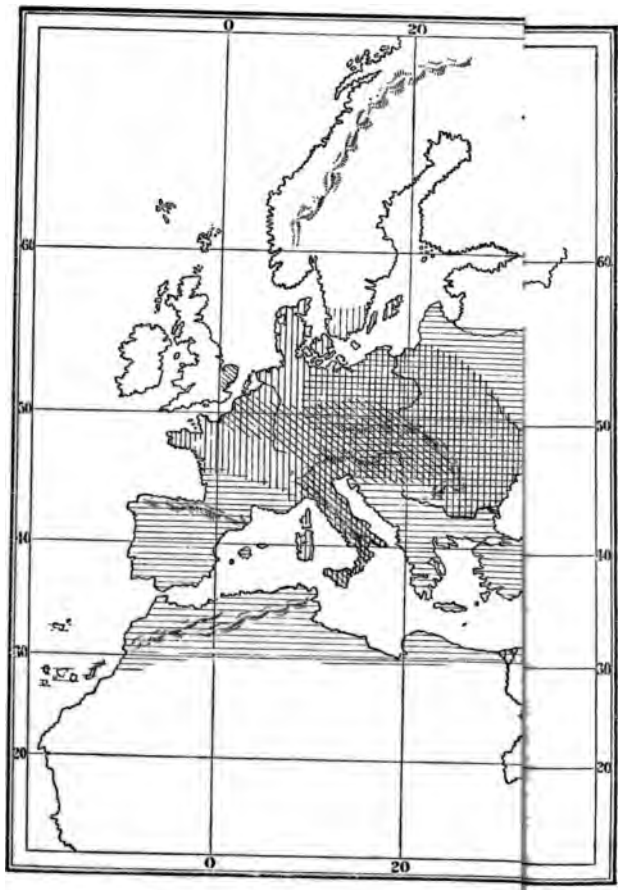
8. RANA.

Linnæus, Syst. Nat., p. 354 (1766).—Partim.

Pupil horizontal. Tongue free and forked behind. Vomerine teeth. Tympanum distinct or hidden. Fingers free; toes webbed; outer metatarsals separated by web. Omosternum and sternum with a strong bony style.

The distribution of this genus is the same as that of the family, but only one species, out of about 160 that are now known, is found in the tropical parts of South America, and one in the extreme north of Queensland; the great bulk belong to the Indian

63.



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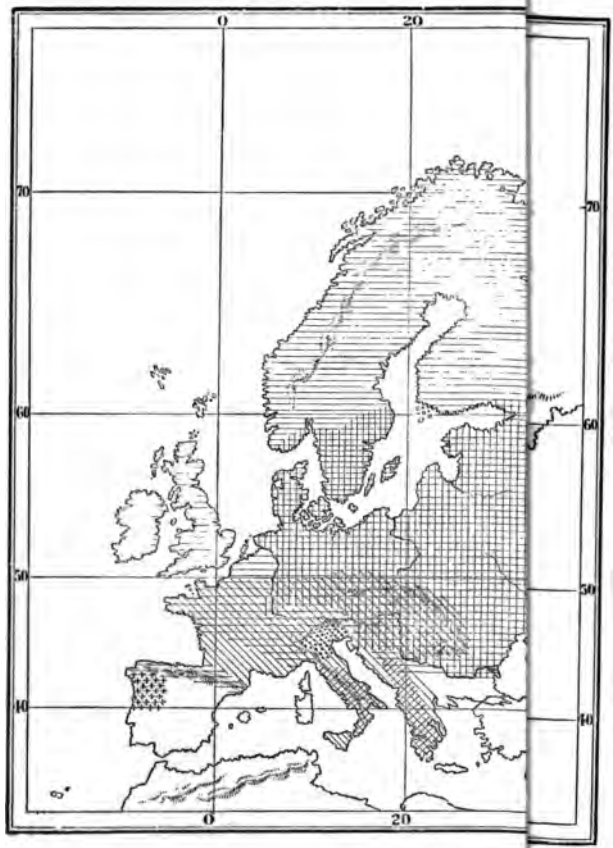

DISTRIBUTIO

region. Eight species are known to occur in Europe; they may be distinguished by means of the following synopsis:

I. Vomerine teeth between the choanæ or extending slightly beyond their posterior borders; inter-orbital space very narrow, measuring one-third to one-half the width of the upper eyelid; male with external vocal sacs; colour often green. *R. esculenta.*

II. Vomerine teeth behind the level of the choanæ; vocal sacs internal or absent; colour never green.

A. Tibio-tarsal articulation rarely reaching the tip of the snout and never beyond; distance between the dorso-lateral glandular folds contained five to seven times in the length from snout to vent; male with internal vocal sacs.

Inner metatarsal tubercle large, hard, compressed, measuring one-half to two-thirds its distance from the tip of the inner toe; first finger extending beyond second; tibia shorter than the fore limb. *R. arvalis.*

Inner metatarsal tubercle small, soft, oval; first and second fingers equal, or first extending slightly beyond second; tibia as long as or slightly shorter than the fore limb . . . . . *R. camerani.*

Inner metatarsal tubercle small, soft, oval; first finger extending beyond second; tibia considerably shorter than the fore limb. *R. temporaria.*

B. Tibio-tarsal articulation reaching the tip of the snout or beyond; tibia as long as or a little shorter than the fore limb; distance between the dorso-lateral glandular folds contained four to five and a half times in the length from snout to vent; male without vocal sacs.

1. Tympanum measuring one-half to two-thirds the diameter of the eye, from which it is separated by a distance equal to one-half to once its own diameter.

Distance between the nostrils greater than the interorbital width; tympanum moderately or feebly distinct; first finger not extending or extending but very slightly beyond second; inner metatarsal tubercle two-fifths to one-half the length of the inner toe, as long as the diameter of the tympanum.

R. græca.

Distance between the nostrils a little greater than the interorbital width; tympanum very distinct; first finger not extending or extending but very slightly beyond second; inner metatarsal tubercle one-third the length of the inner toe, shorter than the diameter of the tympanum. *R. iberica.*

Distance between the nostrils not greater than the interorbital width; tympanum very distinct; first finger extending beyond second; inner metatarsal tubercle one-third the length of the inner toe, shorter than the diameter of the tympanum. *R. latastii.*

2. Tympanum measuring two-thirds to four-fifths the diameter of the eye, and close to the latter; first finger extending beyond second; subarticular tubercles and inner metatarsal tubercle very prominent.

R. agilis.

Two maps are appended to show the distribution of these species. The first deals with *Rana esculenta* and its varieties, the second with the remaining species forming the section named "*Ranæ fuscæ*" by Fatio, and "*Ranæ temporariæ*" by Lataste, which have long been confounded under the Linnean name *Rana temporaria.*

Rana esculenta, var ridibunda.

13. RANA ESCULENTA.

(Plates XVI and XVII.)

Rösel, Hist. Ran., p. 53, pls. xiii—xvi (1758).

Rana esculenta, Linnæus, Faun. Suec., 2nd ed., p. 102 (1761), and Syst. Nat., i, p. 357 (1766); Laurenti, Syn. Rept., pp. 31 and 136 (1768); Müller, Zool. Dan. Prodr., p. 35 (1776); Sturm, Deutschl. Faun., iii, Heft 1 (1799); Shaw, Gen. Zool., iii, p. 103, pl. xxxi (1802); Daudin, Hist. Rain. Gren. Crap., p. 46, pl. xv, fig. 1 (1803), and Hist. Rept., viii, p. 90 (1803); Eichwald, Zool. Spec. Ross. Pol., iii, p. 166 (1831); Schlegel, Faun. Japon., Rept., p. 109, pl. iii, fig. 1 (1836); Bonaparte, Icon. Faun. Ital., Rett. Anf. (1837); Nilsson, Skand. Faun., Amf., p. 88 (1842); Bell, Brit. Rept., 2nd ed., p. 110, fig. (1849); Massalongo, Erp. Veron., p. 47 (1854); Günther, Cat. Batr. Sal., p. 12 (1858), and Rept. Brit. Ind., p. 408 (1864); Collin, Naturh. Tidsskr. (3), vii, 1869, p. 280; Koch, Ber. Senck. Ges., 1872, p. 135; Fatio, Vert. Suisse, iii, p. 312 (1872); De Betta, Faun. Ital., Rett. Anf., p. 63 (1874); Boettger, Abh. Senck. Ges., ix, 1874, p. 165; Schreiber, Herp. Eur., p. 177 (1875); Leydig, An. Batr., p. 104 (1877); Lessona, Atti Acc. Lincei, Mem. Cl. Sc. fis., i, 1877, p. 1050, pl. i; Lataste, Bull. Soc. Zool. France, 1880, p. 61; Camerano, Bull. Ass. Franç., 1881, p. 680; Boulenger, Cat. Batr. Ecaud., p. 38 (1882); Pflüger, Arch. Ges. Physiol., xxix, 1882, p. 67; Camerano, Mem. Acc. Torin. (2), xxxv, 1883, p. 241, pl. i, fig. 1; Boulenger, The Zool., 1884, pp. 220 and 265, and Proc. Zool. Soc., 1884, p. 573, pl. lv; Héron-Royer, Bull. Soc. Et. Sc. Angers, xiv, 1885, p. 110; Bedriaga, Bull. Soc. Nat. Moscou, 1889, p. 242; Boulenger, Proc. Zool. Soc., 1891, pp. 374 and 604, pl. xlv, fig. 1; Méhely, Beitr. Mon. Kronstadt, Herp., p. 51 (1892); Douglass, Herp. Baden, p. 38 (1894); Werner, Rept. Amph. Oesterr.-Ung., p. 86 (1897); Dürigen, Deutschl. Amph., p. 422, pl. iv, fig. 1 (1897).

Rana ridibunda, Pallas, Reise, i, p. 458 (1771).

Rana chinensis, Osbeck, Voy. China, i, p. 299 (1771); Bonnaterre, Encycl. Méth., Erp., p. 6 (1789).

Rana vulgaris, Lacépède, Quadr. Ov. i, Syn. Méth. and p. 503 (1788).

Rana maritima, Risso, Hist. Nat. Eur. Mér., iii, p. 92 (1826); Bonaparte, l. c. (1839); Girard, U. S. Explor. Exped., Herp., p. 25, pl. ii, figs. 7—12 (1858).

Rana cachinnans, Pallas, Zoogr. Ross.-As., iii, p. 7, pl. i, figs. 1 and 2 (1831); Eichwald, Zool. Spec., iii, p. 166, and Faun. Casp.-Cauc., iii, p. 126, pl. xxx (1841).

Rana caucasica, Pallas, l. c.

Rana dentex, Krynicki, Bull. Soc. Nat. Moscou, 1837, pt. iii, p. 63, pl. ii.

Rana hispanica (Fitzinger), Bonaparte, l. c.
Rana calcarata (non Michahelles), Tschudi, Class. Batr., p. 80, pl. i, fig. 1 (1838).
Rana fluviatilis (Rusconi), Bonaparte, Mem. Acc. Torin. (2), ii, 1839, p. 249.
Rana tigrina (non Daudin), Eichwald, l. c.
Rana viridis (non Linnæus), Duméril & Bibron, Erp. Gén., viii, p. 343 (1841); Lataste, Herp. Gir., p. 224 (1876); Héron-Royer & Van Bambeke, Arch. Biol., ix, 1889, p. 250; Martin & Rollinat, Vert. Dép. Indre, p. 323 (1894).
Rana esculenta, var. *japonica*, Maack, Voy. Amour, p. 153 (1859); Boulenger, Cat. Batr. Ecaud., p. 40 (1882).
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Rana esculenta, var. *viridis*, Camerano, Bull. Ass. Franç., 1881, p. 680, and Mem. Acc. Torin. (2), xxxv, 1883, p. 243.
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Rana esculenta, var. *cachinnans*, Camerano, ll. cc.
Rana esculenta, var. *bedriagæ*, Camerano, ll. cc.
Rana esculenta, var. *latastii*, Camerano, ll. cc.
Rana porosa, Boulenger, l. c.
Rana fortis, Boulenger, The Zool., 1884, p. 220.
Rana esculenta, var. *ridibunda*, Boulenger, Proc. Zool. Soc., 1885, p. 666, pl. xl; Boettger, in Radde, Faun. Flor. Casp.-Geb., p. 76 (1886), Sitzb. Ak. Berl., 1888, p. 145, and Zool. Jahrb., iii, 1888, p. 953; Walter, Zool. Jahrb., iii, 1888, p. 976; Boulenger, Proc. Zool. Soc., 1891, p. 374, and Tr. Zool. Soc., xiii, 1891, p. 157; Werner, Verh. Zool.-bot. Ges. Wien, xli, 1891, p. 758; Boettger, Ber. Senck. Ges., 1892, p. 133; Méhely, Zool. Anz., 1894, p. 78; Werner, Verh. Zool.-bot. Ges. Wien, xliv, 1894, pp. 86 and 234.
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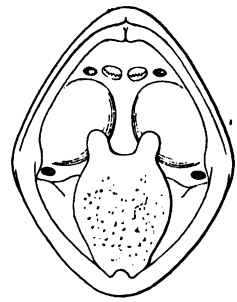
Rana esculenta, var. *hispanica*, Bedriaga, Bull. Soc. Nat. Moscou, 1889, p. 258, and Amph. Rept. Portug., p. 5 (1889); Steindachner, Ann. Hofmus. Wien, vi, 1891, p. 304.
Rana esculenta, var. *nigromaculata*, Boulenger, Proc. Zool. Soc., 1891, p. 376.

Vomerine teeth in two transverse or more or less oblique groups between the choanæ or extending slightly beyond their posterior borders.

Head as long as broad or a little broader than long; snout rounded or obtusely pointed, projecting beyond the mouth, as long as or a little longer than the diameter of the orbit; canthus rostralis obtuse; loreal region very oblique; nostril equally distant from the eye and the tip of the snout or nearer the former; interorbital space narrow, one-third to one-half the width of the upper eyelid, narrower than the space between the nostrils, and often distinctly grooved longitudinally; tympanum very distinct, one-half to three-fourths the diameter of the eye.

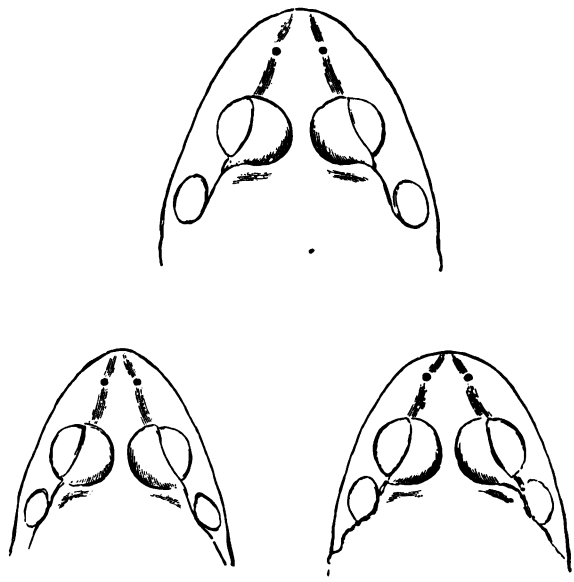
FIG. 97.



Open mouth.

Fingers obtusely pointed, first a little longer than second; subarticular tubercles small, moderately prominent.

FIG. 98.



Upper views of heads of German specimens (var. *ridibunda*).
[From P. Z. S., 1885.]

Hind limb very variable in length; the tibio-tarsal articulation reaches between the shoulder and the tip of the snout; tibia as long as or shorter than the fore limb, as long as, longer, or shorter than the thigh. Foot as long as or longer than the tibia; toes entirely or almost entirely webbed, with small subarticular tubercles; inner metatarsal tubercle varying in shape and size according to the varieties, oval and feebly prominent or compressed and crescentic; a small rounded tubercle usually present at the base of the fourth toe.

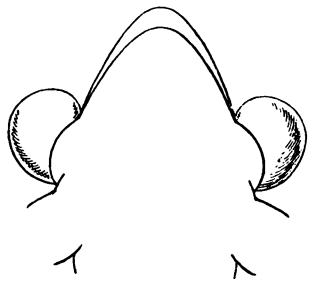
Skin smooth or verrucose, usually with small granular asperities on the sides and hind limbs; a prominent glandular dorso-lateral fold; these folds parallel or slightly diverging towards the sacrum, the distance between them on the scapular region one-sixth to one-fourth the length from snout to vent; a short glandular fold behind the angle of the mouth; more or less distinct glandular ridges may run along the upper surface of the tibia; lower parts smooth, more or less distinctly granulate or areolate on the hinder part of the belly and under the thighs.

Upper parts brown, green, olive, or blue, uniform or spotted with dark olive or black, often with a light yellow, green, or blue vertebral stripe; glandular lateral folds usually golden or bronzy; hind limbs with or without dark cross-bars; hinder side of thighs usually with dark marblings; a dark temporal spot sometimes present; lower parts white, uniform or spotted or marbled with blackish. Iris golden, or black and golden.

Males distinguished by stronger fore limbs, a pad-like swelling at the base of the inner finger, covered during the breeding season with grey horny granules, and an external vocal sac on each side of the head; this sac issues from a slit in the skin behind the angle of the jaws, the length of which about equals the diameter of the orbit. A more or less distinct fold in the position of the vocal sac is usually visible in the females, and in a large female from Pisa I even find

the sac actually developed, although smaller than in the males.

FIG. 99.



Lower view of head of male, showing inflated vocal sacs.

VARIATIONS.—It is a well-known fact that the edible frog presents a greater amount of variation, both as regards structure and coloration, than perhaps any other species of Batrachians. No herpetologist having before him the Japanese and Spanish frogs, without a knowledge of the intermediate forms, would hesitate to pronounce them as representing different species; they have, in fact, been referred to distinct genera by such experienced workers as Peters and Cope. But if we pursue our investigations over the wide area occupied by this frog, viz. the whole of the Palæarctic region, we soon find all the differences by which we were at first struck to blend through such a number of intermediate forms as to leave no other course open but to maintain intact the Linnean species. However, a great difficulty still remains to be dealt with: the principal of the differences ascertained are not merely individual; nor are they entirely dependent on locality or climate, as almost identical specimens are met with at such distant points as North Germany, the Sahara, and Baluchistan. And, what is more striking still, in the case of two forms occurring in the same locality they may be perfectly separable and not interbreed, as has been shown to be the case

in Germany. It is, therefore, not serving the interest of exact taxonomy and zoogeography to be satisfied with the comprehensive notion of *Rana esculenta*. Attempts should be made at a division of the specific type into races or sub-species. With this object in view, I have for the last fifteen years been amassing material and information, and have subjected the many hundreds of specimens which have passed through my hands to a most minute examination and comparison.

The first attempt at subdividing *Rana esculenta* into sub-species, published by Camerano in 1881, proved on the whole a failure. In various papers contributed since 1884 I have endeavoured to throw some light on the matter; and have ultimately proposed, in 1891, to divide the species into four principal forms, viz.—

1. Var. RIDIBUNDA, Pall. (*cachinnans*, Pall.; *caucasica*, Pall.; *tigrina*, Eichw.; *dentex*, Kryn.; *? maritima*, Risso; *hispanica*, Fitz.; *latastii*, Camer.; *bedriagæ*, Camer.; *fortis*, Blgr.; *perezi*, Seoane).

The largest and most widely distributed form, inhabiting the whole of Europe with the exception of the north-western and central parts and Italy, Western Asia as far east as North Baluchistan, Afghanistan, and Eastern Turkestan, and North Africa. As being on the whole the least specialised form, *i. e.* departing less from the normal pattern of the genus to which it belongs, it deserves to rank first in the list, although the denomination of *forma typica* pertains to the next form, as having been first described under the name of *Rana esculenta*.

2. FORMA TYPICA (*esculenta*, L.; *sylvatica*, Koch). Northern and Central Europe and Italy.

3. Var. LESSONÆ, Camer.

The habitat of this frog, which in its characters is intermediate between the preceding and the next, is

still very incompletely ascertained, specimens being known from England (Cambridgeshire and Norfolk), the Rhine, Upper Bavaria (Matzing), the province Saxony, Austria near Vienna, Hungary (Szamos-Ujvar and Hermannstadt), Piedmont, and probably other parts of Italy as well as Sicily, where it occurs according to Camerano. A specimen stated to be from Malta, which I received from the Zoological Society, was probably imported from Italy or Sicily. To my surprise I captured, in September, 1895, a few specimens in a small pond at Berchem-St.-Agathe, near Brussels. I had not previously met with that form in Belgium. I again came across the same variety in April, 1897, in a pond at Mesnil-St.-Blaise, near Givet, where it was very abundant, and where the typical form seemed to be absent.

I have also lately ascertained its presence near Paris. Whilst looking over M. Lataste's collection I was struck by a female specimen from Bondy which belongs to this variety, and which I find had not remained unnoticed by the excellent herpetologist to whom we owe its discovery in France. Although he had quite correctly estimated its relationship to the Italian form, the name under which he designated it* can hardly have precedence over that proposed by Camerano, who was the first to give a precise definition of this frog and assign it its correct place in the system. The same form had also been named, and in a certain way defined, by Bonaparte in 1839 as "*Rana fluviatilis*, Rusconi, artubus brevissimis, coloribus luridis."

As mentioned further on, the British specimens are perhaps introduced from Italy. Now, however, that the habitat of the var. *lessonæ* is known not to be

* "J'ai trouvé à Bondy une jolie variété de cette espèce, plus petite, plus dodue, plus vivement colorée, rappelant celle qui servit à Spallanzani pour ses fameuses expériences sur la génération. Du moins répond-elle fort bien à la courte description de cet Anoure. A. de l'Isle croit, avec Spallanzani, que cette forme mérite d'être spécifiquement distinguée, et lui donne le nom de *Rana meridionalis*."—Lataste, 'Act. Soc. Linn. Bord.' (4), i, 1876, p. 13.

confined to Italy, the origin of these colonies is more obscure than ever.

4. Var. CHINENSIS, Osb. (*marmorata*, Hallow.; *nigro-maculata*, Hallow.; *reinhardti*, Ptrs.; *porosa*, Cope; *japonica*, Blgr.).

An Eastern form, ranging from Corea and Japan to Southern China and Siam; the exact western limits of its habitat have still to be ascertained, and it would be particularly desirable to know whether it anywhere comes into contact with, or overlaps the area of the *ridibunda* form.

The principal characters which have proved of service in diagnosing these forms are the following:

1. The development of the inner metatarsal tubercle, whether large or small, blunt or compressed. The length is taken along the attachment of the tubercle to the foot; the length of the first toe, given for comparison, is taken from the tubercle; and the length of the latter is also compared to the length of the crus or tibia measured in the flesh.

2. The comparative length of the tibia to the thigh. This is shown by pressing the two close together and maintaining the tibia at right angle to the axis of the body; the tibial extremity, or heel, is then found to overlap, to meet, or to fail to meet its fellow placed in the same position. Only in Form 1 do they overlap, and this character alone differentiates it from the three others.

3. The presence or absence of short glandular folds along the back, in addition to the dorso-lateral. The presence of these folds differentiates Form 4 from the three others.

4. The presence or absence of bright yellow pigment on the lumbar and post-femoral regions. This pigment is constantly absent in Form 1, and very seldom in Form 2. The character unfortunately cannot be made use of with spirit specimens.

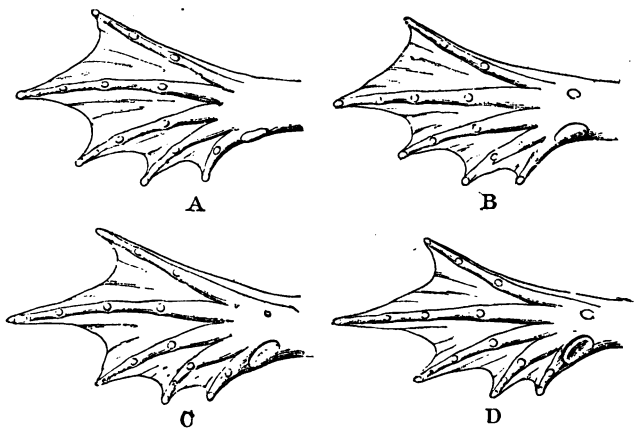
By means of the first three characters we are able

to draw up the following key, which is imperfect only in so far that Forms 2 and 3 are not distinguished from each other in an absolute manner; this difficulty, however, cannot be overcome, as the two forms do run completely into each other, and future investigations may even render their separation unadvisable.

			Metatarsal tubercle.	
No dorsal folds.	Heels overlapping.	1. *ridibunda.*	2½–4 times in length of inner toe.	9½–14 times in length of tibia.
	Heels not overlapping.	2. *typica.*	2–3	7–10
		3. *lessonæ.*	1½–2	5–8
Dorsal folds		4. *chinensis.*	1–1½	5–8

The fourth form, being confined to Asia, will not be further dealt with in this work.

FIG. 100.



Lower views of feet:—A. Var. *ridibunda.* B. *Forma typica.* C. Var. *lessonæ.* D. Var. *chinensis.*

Var. RIDIBUNDA.

Inner metatarsal tubercle small, blunt, feebly prominent, its length 2½ to 4 times in the length of the inner toe measured from the tubercle, and 9½ to 14 times in the length of the tibia; when the limbs are folded at right angles to the rhachis the heels overlap; tibia as long as, or slightly shorter than the foot measured from the outer metatarsal tubercle. The tibio-tarsal articulation reaches the eye, the tip of the

snout, or between these two points. Snout usually shorter and less pointed than in the typical form. Skin smooth or more or less warty; glandular lateral fold more or less prominent, frequently as broad as the upper eyelid.

Specimens from the south of France, the Spanish Peninsula, and North Africa, vary much in colour—olive, dull green, bronzy-brown, or bright green above, spotted or speckled with dark olive or blackish, with or without a light vertebral stripe; the hinder side of the thighs whitish or pale olive, marbled or vermiculate with blackish; belly white, uniform or with small blackish spots.

German specimens are less variable. In the normal condition the ground colour of the upper parts is olive or bronzy-olive, with the vertebral stripe, the fore limbs, and the sides of the head and body pale green or pale olive. But of course, through the play of the chromatophores, the same individual may pass successively from a very light to a very dark hue, according to its being placed in very dry or very moist surroundings. In specimens long kept in water the colour turns to a very dark bronze-olive, almost blackish, in which case the normally darker markings may assume a brighter greenish tint; but if these markings are examined with a magnifying glass, they are seen to be black beautifully powdered with gold. The vertebral stripe varies considerably in width, and may be absent altogether. The glandular lateral folds are usually not conspicuously lighter coloured, though sometimes metallic bronzy. The spots on the back and flanks are more or less numerous, but these markings are of a blackish-olive or bronzy-brown, and never of an intense black as in the typical form. The dorsal spots sometimes form pretty regular longitudinal series, but are never confluent into longitudinal bands. A dark canthal and supra-temporal streak is usually present, and sometimes expands into a regular temporal spot. The edge of the upper lip is either

spotless or with a series of blackish spots, which very seldom unite to form a labial streak. The cross-bands on the legs may be very irregular or absent. The hinder side of the thighs, *i. e.* that part which is concealed by the legs when the animal is at rest, is whitish or pale greenish marbled with dark olive or bronzy, or of the latter colour with or without small light spots; never is any trace of yellow to be detected on that region nor at the axil and groin. The lower surfaces are white, with greyish spots or marblings in specimens kept dry. After long sojourn in water these parts are abundantly spotted or largely marbled with black. The abundance and intensity of these spots is irrespective of sex—a remark which, contrary to the statement of many authors, applies also to the typical form. The iris is black, veined with gold, the latter pigment being in far lesser abundance than in the typical form. The vocal sacs are strongly pigmented with black, pale grey when swollen out.

MEASUREMENTS (in millimetres).

	♂				♀			
	1.	2.	3.	4.	5.	6.	7.	8.
From snout to vent	65	88	95	65	85	104	100	125
Length of head	20	30	29	22	27	32	30	38
Width of head	23	32	35	23	33	36	38	46
Diameter of eye	7	8	9	7	9	8	9	11
Interorbital width	2	3	3	2	3·5	3	3·5	5
From eye to nostril	4	6	6	4	5·5	7	6	8
,, end of snout	9	13	14	10	13	15	14	19
Diameter of tympanum	4·5	6	6	4·5	6	7	6·5	8
Fore limb	39	48	57	40	50	49	55	69
Hind limb	109	135	150	108	146	160	155	177
Tibia	34	42	47	33	44	50	50	56
Foot	34	44	50	33	44	51	50	56
Inner toe (from tubercle)	10	12	13	10	12	15	15	16
Inner metatarsal tubercle	3	4	5	3·5	4·5	4·5	5	6

1. Cadillac, Gironde: Lataste.
2, 6. Berlin: Boulenger.
3. Astrachan: St. Petersb. Mus.
4. Hammam Rirha, Algeria: Anderson.
5. Alemtejo, Portugal: Gadow.
7. Elizabethpol: St. Petersburg Mus.
8. Damascus: T. Barrois.

As may be seen from the preceding table of measurements, this form reaches to a very large size, much exceeding that of the two others.

FORMA TYPICA.

Inner metatarsal tubercle strong, compressed, prominent, its length 2 to 3 times in the length of the inner toe measured from the tubercle, and 7 to 10 times in the length of the tibia; when the limbs are folded at right angles to the body, the heels meet or remain narrowly separated; tibia shorter than the foot measured from the outer metatarsal tubercle. The tibio-tarsal articulation reaches the eye or between the eye and the tip of the snout. Skin smooth or with small warts; glandular lateral fold very prominent, as broad as or narrower than the upper eyelid.

Bright green, brown, or blue above, uniform or spotted with black; hinder side of thighs handsomely marbled with black, and usually with more or less of bright yellow pigment; vocal sacs white or feebly pigmented. Iris golden, with or without black vermiculations.

Males are often of a uniform green colour, without any markings; females are usually more or less spotted with black, the spots sometimes confluent into longitudinal bands. A light, pale blue, pale green, or yellowish-green vertebral stripe is often present, and the glandular lateral folds are usually of a beautiful gold-colour. A blackish temporal spot is sometimes present. Black cross-bars are usually present on the hind limbs in the females, more often absent or ill-defined in the males.

Sky- or turquoise-blue specimens are rare, and must be regarded as individual abnormalities due to the absence of the yellow pigment, same as occur also in *Hyla arborea*, a fine blue specimen of which (var. *meridionalis*) was exhibited last summer at the Zoological Gardens, London. Vulpian (C. R. Soc. Biol.

Rana esculenta.

[5], iv, 1872, p. 201) appears to have been the first to record blue specimens of *R. esculenta;* others have since been examined by Pflüger and by Leydig at Bonn, by Norman Douglass in Baden, and by myself at Frankfort-on-the-Main. I have also received a specimen from Basle through the late Dr. F. Müller.

Brown specimens, without or with little green, as in the specimens of var. *lessonæ* from Norfolk, are not uncommon near Berlin. The var. *sylvatica* of Koch is based on such a specimen. I have examined the type of the latter, a female, which measures 67 mm. from snout to vent; hind limb 92; tibia 26; foot 27; inner toe 6; inner metatarsal tubercle 3.

MEASUREMENTS (in millimetres).

	♂				♀			
	1.	2.	3.	4.	5.	6.	7.	8.
From snout to vent	73	68	64	65	84	85	90	60
Length of head	24	22	21	21	26	26	28	20
Width of head	25	23	22	21	29	29	32	21
Diameter of eye	8	7	7	7	8	7	8	6·5
Interorbital width	1·5	2	2	2·5	2·5	3	2·5	2
From eye to nostril	4	4	4	4	5	5	6	4
From eye to end of snout	10	10	10	10	12	12	13	9·5
Diameter of tympanum	6	4	4·5	4	6	5	6	4
Fore limb	40	39	37	39	44	43	50	32
Hind limb	106	102	100	109	123	125	137	94
Tibia	33	30	30	34	38	35	42	28
Foot	35	35	33	36	40	38	45	31
Inner toe (from tubercle)	8·5	8·5	8	9	10	9	12	8
Inner metatarsal tubercle	3·5	4	4	3·5	4	5	5·5	3·5

1. St. Malo: Boulenger.
2. Copenhagen: Lütken.
3. Vienna: Wernen.
4, 8. Naples: Monticelli.
5. Paris: Boulenger.
6. Lolland: Lütken.
7. Warsaw: Wrzeniowski.

The range of variation of the somewhat complex assemblage which I have endeavoured to define as the *typical form* is very great indeed, and forms a graduated series leading from the form *ridibunda* to the form *lessonæ*. I must confess that the line drawn

between the latter and the typical form appears to me arbitrary, and that my arrangement is open to this criticism, that there is altogether a greater amount of difference between the two extremes of the series than there is between the extreme in the *lessonæ* direction and the form *lessonæ* itself. The true typical *R. esculenta*, as figured by Rösel, is pretty well in the middle of the series; the outermost specimens with small inner metatarsal tubercle are from France, Corsica, and Italy; whilst the opposite obtains in specimens from Basle and Vienna.

Var. LESSONÆ.

Inner metatarsal tubercle very strong, compressed, hard, crescentic, its depth about half its length, which is $1\frac{1}{2}$ to 2 times in the length of the inner toe, and 5 to 8 times in the length of the tibia; when the limbs are folded at right angles to the body the heels sometimes meet, but usually fail to meet; tibia considerably shorter than the foot measured from the outer metatarsal tubercle. The tibio-tarsal articulation reaches between the shoulder and the eye. Skin smooth or with small warts; glandular lateral fold very prominent, narrower than the upper eyelid.

Bright green or brown above, the black markings sometimes forming longitudinal bands; hinder side of thighs handsomely marbled with black on a bright yellow or orange ground; vocal sacs not, or but very slightly pigmented.

British specimens are olive-brown or bronzy-brown above, spotted with black, strongly marbled on the flanks, where a light longitudinal area remains unspotted; glandular folds lighter; the sides of the head and the ground colour of the flanks sometimes green; canthal streak well marked, black; upper lip usually bordered with black; tympanum chestnut-brown; a pale yellow or pale green vertebral line, frequently edged with black. The dark cross-bands on the limbs usually very irregular, sometimes absent.

Lower surfaces more or less profusely spotted with blackish. Iris golden.

The enormous differences of proportions separating this variety from the other extreme, the var. *ridibunda*, may be realised by comparing the measurements in the following table with those given on p. 275.

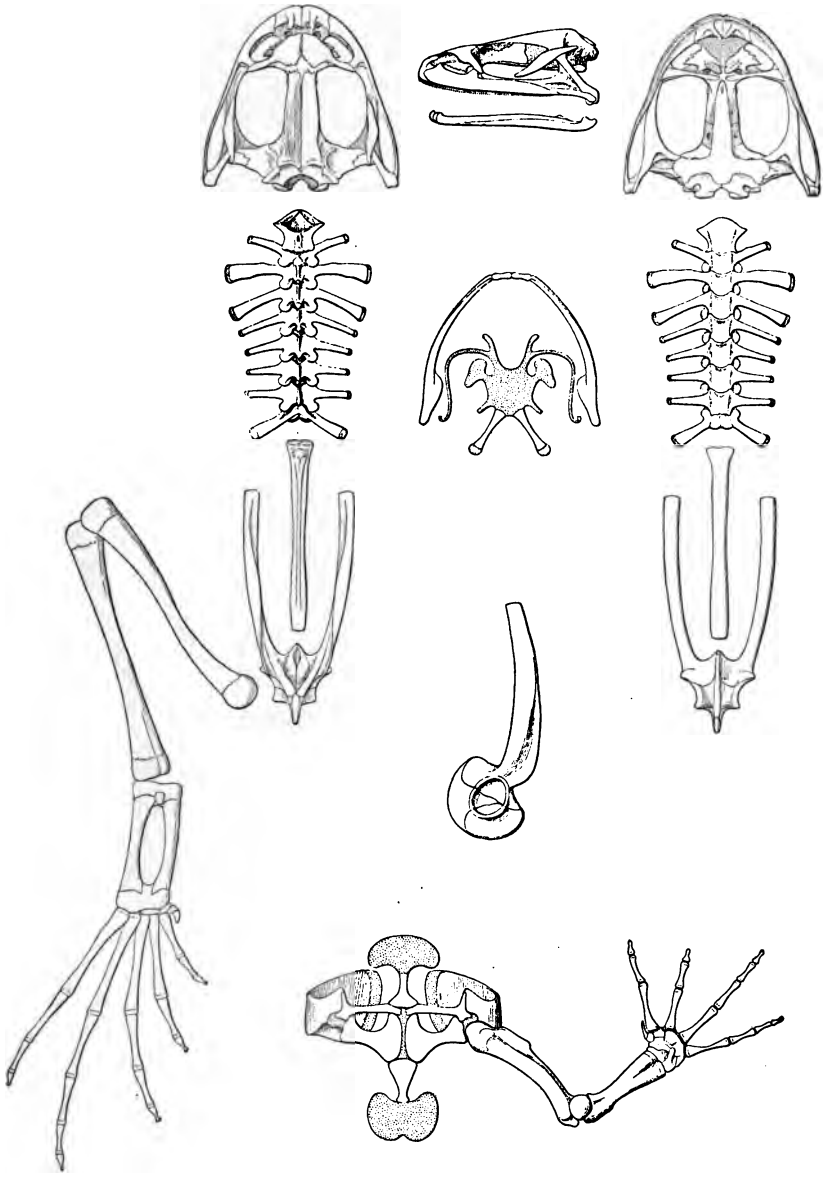
MEASUREMENTS (in millimetres).

	♂			♀			
	1.	2.	3.	4.	5.	6.	7.
From snout to vent	64	53	48	78	55	73	60
Length of head	22	18	17	29	18	23	19
Width of head	22	19	18	28	19	25	21
Diameter of eye	6	6	5·5	8	5·5	7	6
Interorbital width	2·5	2	1·5	3	2	2·5	2·5
From eye to nostril	4·5	3	3	5	3·5	5	4
„ end of snout	10	8	8	12	8	11	9
Diameter of tympanum	4	3	3·5	5·5	3·5	5	4·5
Fore limb	34	31	29	42	29	40	32
Hind limb	97	82	77	110	80	105	90
Tibia	25	24	23	30	24	31	25
Foot	34	28	27	39	28	37	31
Inner toe (from tubercle)	7·5	6	6	9	6·5	8	7
Inner metatarsal tubercle	5	3·5	3·5	6	3	5	4·5

1, 4. Stow Bedon, Norfolk: Walsingham.
2, 5. Offenbach: Bedriaga.
3, 6. Piedmont: Camerano.
7. Szamos Ujvar, Hungary: Méhely.

SKELETON.—The skull is remarkable for the extreme narrowness of the interorbital region, its width being only about one-third the length of the fronto-parietal bones; these are more or less distinctly grooved along the median line, and do not extend quite to the anterior borders of the orbits, a small portion of the ethmoid remaining uncovered and forming an obtuse point anteriorly; the fontanelle is also more or less exposed in specimens that are not full-grown. Nasals rather large, oblique, forming together an obtuse angle, in contact or narrowly separated on the median line; their posterior border usually nearly straight. Squamosal large, the zygomatic process long and pointed, nearly twice as long as the posterior

FIG. 101.



Skeleton of female, var. *ridibunda*.

process. Vomers rather large, in contact with each other or narrowly separated in the middle. Palatines well developed. Pterygoid with the anterior branch the longest and reaching the palatines. Parasphenoid dagger-shaped, the handle very short, the blade long and pointed, extending to or nearly to the palatines. Occipital condyles on a line with the articular extremities of the upper jaw. Symphysial bones very distinct, thinner than and well distinguishable from the mandibular rami, although fused with the dentary in the adult.

Vertebral column once and three-fourths to twice as long as the skull. Vertebræ open above, between the zygapophyses, and at the sides, with a low but very distinct neural crest; diapophyses slender, subcylindrical, not very unequal in length, with the exception of the second, which is longer than the rest and more flattened; first diapophysis directed slightly forwards; third, or third and fourth, slightly backwards; the others horizontal, or the seventh again directed forwards. Diapophyses of sacral vertebra cylindrical, directed slightly backwards; two condyles for articulation with urostyle. Latter a little shorter than the rest of the vertebral column, with strong crest in the anterior three-fourths, without transverse processes.

Præcoracoids slender, horizontal; coracoids much stronger, greatly expanded towards the median line; omosternum and sternum with a bony style. Suprascapula partially ossified. Humerus once and a half to once and two-thirds the length of radius-ulna. Six bones in the carpus, two in contact with radius-ulna; two bones in the pollex. Pelvis about two-thirds the length of the vertebral column, the ilia articulating with the extremities of the sacral diapophysis. Pubis large, ossified or calcified, entering the acetabulum. Femur feebly curved. Astragalus and calcaneum nearly equal in length, connected at both ends by a calcified epiphysis; the long bones also with calcified epiphyses. A minute sesamoid bone

on the inner side of the tarsus near its articulation with the tibia. Two bones in the distal tarsal row, and two in the præhallux. Terminal phalanges obtuse.

The different races are only distinguished by the proportions of the femur and crus and the size and form of the præhallux, as indicated externally.

MEASUREMENTS (in millimetres).

	Var. *ridibunda*.		*F. typica*.		Var. *lessonæ*.	
	♂	♀	♂	♀	♂	♀
Length of skull	26 ...	33 ...	21 ...	27 ...	16 ...	22
Width of skull	29 ...	37 ...	22 ...	31 ...	17 ...	22
Least interorbital width	3·5 ...	4 ...	3 ...	3·5 ...	2·5 ...	3
Dorsal vertebral column	28 ...	35 ...	21 ...	30 ...	16 ...	21
Urostyle	26 ...	37 ...	21 ...	28 ...	14 ...	21
Humerus	23 ...	28 ...	19 ...	23 ...	14 ...	18
Radius-ulna	14 ...	17 ...	13 ...	15 ...	8 ...	12
Manus	21 ...	27 ...	19 ...	22 ...	14 ...	16
Pelvis	33 ...	45 ...	28 ...	37 ...	19 ...	27
Femur	38 ...	47 ...	32 ...	38 ...	20 ...	29
Tibia	42 ...	51 ...	33 ...	38 ...	21 ...	29
Tarsus	20 ...	25 ...	17 ...	19 ...	12 ...	15
Pes	42 ...	53 ...	40 ...	43 ...	28 ...	34

HABITS.—The so-called "edible frog" is the most aquatic of our Batrachians. The young are sometimes found at some distance from water, but the adults keep to ponds and ditches or even rivers (var. *ridibunda*) and their banks, on which they may be found sunning themselves on fine days, ready to plunge into the water at the least disturbance and conceal themselves for a while in the mud. Their loud and varied croaking,—*brekeke* and *croäx* being the most characteristic utterances,—in which they indulge day and night, especially during the breeding season, has attracted notice from the most remote antiquity. The flesh of their hind quarters is much esteemed as a delicacy, but owing to the late appearance of this species in spring, *R. temporaria* is the kind drawn upon on the Brussels, Paris, and Geneva markets during Lent-time, at which season great quantities are consumed. In the late spring and summer this species is more easily procured in large numbers, and there

are men in France who earn a living for six months in the year by frog-fishing. No tackle is used: a piece of red flannel, or better the skin of a frog, rolled-up in a ball about the size of an acorn, attached to a line, is agitated at the surface of the water and greedily seized by the frog, which is hauled up before it has time to let go. An interesting account of this mode of capture has been published by R. Rollinat, 'Bull. Soc. Aquic. France' (2), vi, 1894, p. 37. This frog is very voracious, and large specimens will occasionally capture snakes and small mammals and birds.

Pairing does not take place, in the typical form, until May in the northern parts of the Continent, earlier in the south, viz. end of March or beginning of April in Southern Italy. The var. *ridibunda* breeds about a fortnight sooner, near Berlin towards the beginning or middle of May, and the spawning appears to be usually over by the time the typical form sets to this duty, which also lasts over a more extended period, often until the end of June or beginning of July. This difference in the spawning season is the important factor which permits the existence in the same locality of two forms so closely allied and, as ascertained by Pflüger, fertile when crossed, occasions for interbreeding being comparatively rare. We have thus here an example of what is known in botany as "asyngamy." As far as my experience goes, the females of the var. *ridibunda* get rid of their eggs within a very few days. On the 27th May, 1884, I received from Berlin 85 specimens of the var. *ridibunda* and 41 of the typical form, and found that all the females of the former were spent, whereas all the latter were full of ova. In May, 1886, at Berlin, I observed the *ridibunda* form spawning between the 14th and 20th, whilst the typical form was only beginning to pair; however, owing to the great heat that followed, great numbers of the latter were spawning a few days later.

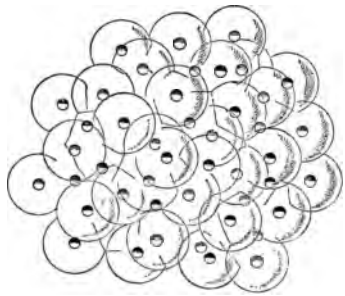
The male clasps the female under the arms, the

hands joining on the breast, or more or less widely separated if the male be much smaller than the female. The eggs are laid in several masses among water plants. The metamorphosis takes place about three months later. Hibernating larvæ are, however, not of unfrequent occurrence.

In a recent paper on oviposition in frogs, Nussbaum states that *R. esculenta*, unlike *R. temporaria*, does not spawn in confinement. This is true in a general way only, as I have myself obtained eggs from Swiss specimens kept in London.

Eggs.—Small; vitellus measuring about 1½ millimetres in diameter, brown above, yellowish below; mucilaginous envelop 7 or 8 millimetres in diameter.

Fig. 102.



About 5000 to 10,000 in number, forming several large lumps. Embryo leaving the egg with external gills and a well-developed tail, olive-brown above, yellowish-white below; the gills unpigmented.

Tadpole (Pl. III, fig. 1).—Length of body once and a half its width, or rather less, about half the length of the tail. Nostrils a little nearer the eyes than the end of the snout. Eyes on the upper surface, equidistant from the end of the snout and the spiraculum, or slightly nearer the latter; the distance between the eyes twice to twice and a half as great as that between the nostrils, and much greater than the width of the

mouth. Spiraculum on the left side, directed upwards and backwards, a little nearer the end of the snout than the anus, visible from above and from below. Anus opening on the right side, close to the lower edge of the subcaudal crest. Tail twice and three-fourths to four times as long as deep, acutely pointed; upper crest convex, a little deeper than the lower, not extending far upon the back; the depth of the muscular portion at its base about half the greatest total depth.

Beak very broadly edged with black, sometimes almost entirely black. Sides and lower edge of the lip bordered with papillæ, which usually stand in two rows; upper lip with a long series of fine teeth, followed on each side by a short series; three series of teeth in the lower lip, the two outer uninterrupted, the third also continuous or narrowly interrupted, the outermost only half to two-thirds as long as the others.

The muciferous crypts are pretty distinct on the head, where they form two series, extending from the end of the snout to the upper borders of the eyes, passing between the nostrils. A pair of dorsal lines are usually distinguishable on each side of the back, close together in front, diverging posteriorly; these lines in the advanced tadpole coalesce to form the dorso-lateral fold of the perfect animal.

Olive or greyish-olive above, speckled with brown; sides with silvery or pale golden spots; belly white; throat pinkish, with mother-of-pearl coloured spots; tail pale greyish, closely spotted, dotted, or vermiculated with grey or blackish; the muscular portion of the tail yellowish, often with three blackish stripes on its basal third. With advancing age, when the hind limbs are approaching their full development, the back assumes a more decidedly greenish colour, and the pale green vertebral stripe, if it is to exist, makes its appearance.

The largest tadpoles of the typical form, collected

by me in Brittany, measure 77 mm., body 23; width of body 18; tail 64; depth of tail 20. Tadpoles of the var. *ridibunda* from Prague measure up to 90 mm., and a specimen from the latter locality 111 mm. long is recorded by Pflüger.

I am not aware of any differences by which to distinguish the various races in the larval state.

Habitat.—Few Batrachians have so wide a range of distribution as *Rana esculenta*, for it not only extends over a great part of the Palæarctic region, but even encroaches upon the Ethiopian and Oriental. It does not spread very far to the north, being absent from Ireland, Scotland, Norway, and Northern Russia; its northernmost limit in Europe is the 59th parallel, and in Asia it is not on record north of Mongolia, Manchuria, and the central island of Japan. To the south it extends to Madeira and the Canary Islands, Morocco, far into the Algerian and Tunisian Sahara, Tripoli, the north coast of Egypt, the Sinaitic peninsula, the head of the Persian Gulf, Northern Persia, Baluchistan, Turkestan, Southern China, Formosa, Hainan, and Siam. It is absent from Sardinia and Malta.

It does not ascend high up the mountains, 3500 feet being, according to Fatio, its altitudinal limit in the Alps.

Rana esculenta occurs in a few places only in England; it used to be found in Cambridgeshire, in Foulmire Fen, where it was discovered in 1844, and Bell assures us that his father, who was a native of Cambridgeshire, had noticed many years before the presence of these frogs at Whaddon and Foulmire, where they were known, from their loud croak, as "Whaddon organs" and "Dutch nightingales." The species was afterwards re-discovered in Norfolk, between Thetford and Scoulton, where it is now still very abundant, and, from inquiries made by Lord Walsingham, must have existed for the last seventy years at least. These frogs belong to the var. *lessonæ*, and differ widely from those found in a few other

places in Norfolk, which are undoubtedly the descendants of a number imported from France and Belgium in 1837, 1841, and 1842, and turned loose in the fens at Foulden and in the neighbourhood.

A great deal of discussion has taken place as to whether the edible frog is indigenous in England or introduced; and the balance of evidence seems to be in favour of the latter supposition, although we do not know when and by whom the Cambridgeshire and Stow Bedon colonies were imported. The fact that they belong to a race specially abundant in Italy, and formerly believed to be confined to that country, has suggested the idea that they may be of Italian origin, perhaps introduced by the monks.

Within the last ten years large numbers of the three forms have been imported from Brussels, Berlin, and Italy, and liberated in various localities in West Surrey and Hampshire. Berlin specimens (var. *ridibunda*) have also been introduced in Bedfordshire and Italian ones in Oxfordshire.

Portuguese specimens of the var. *ridibunda* were introduced in the Azores in the beginning of the century, and have become perfectly acclimatised. The presence of the frog in Madeira and the Canary Islands is also said to be due to importation.

Pls. XVI and XVII are reproduced from the Proceedings of the Zoological Society, 1884 and 1885. The former represents a male and a female of the var. *ridibunda* from the lakes near Berlin. The latter represents on the right side, lower figure, a male of the typical form from Foulden, Norfolk, and two specimens of the var. *lessonæ*, male and female, from Stow Bedon, Norfolk.

14. Rana arvalis.

(Plate XVIII.)

Rana temporaria, Linnæus, Faun. Suec., 2nd ed., i, p. 101 (1761); Camerano, Mem. Acc. Torin. (2), xxxv, 1883, p. 266.

Rana temporaria, part., Linnæus, Syst. Nat., p. 357 (1766); Schlotthauber, Arch. f. Nat., 1844, p. 255; Günther, Cat. Batr. Sal., p. 16 (1858); Schreiber, Herp. Eur., p. 125 (1875); De Betta, Atti Ist. Venet. (2), iv, 1885, p. 45.

Rana terrestris, Andrzejewski, Nouv. Mém. Soc. Nat. Mosc., ii, 1832, p. 342.

Rana arvalis, Nilsson, Skand. Faun., Amf., p. 92 (1842), and 2nd ed., p. 104 (1860); Collin, Naturh. Tidsskr. (3), vi, 1870, p. 291; Leydig, An. Batr., p. 129 (1877); Collett, Vid. Selsk. Forh. Christ., 1878, No. 3, p. 7; M. Weber, Tijdschr. Nederl. Dierk. Ver., iii, 1879, p. 149; Boulenger, Bull. Soc. Zool. France, 1879, p. 169, and Cat. Batr. Ecaud., p. 45 (1882); Pflüger & Smith, Arch. Ges. Physiol., xxxii, 1883, pp. 525, 581, pls. vii & viii; Boulenger, Proc. Zool. Soc., 1886, p. 242, pl. xxiv, and Bull. Soc. Zool. France, 1886, p. 596; F. Müller, Verh. Nat. Ges. Basel, viii, 1887, p. 252; Heller, Zool. Gart., xxix, 1888, p. 177; Wolterstorff, Zeitschr. f. Naturw., lxi, 1888, p. 24; Leydig, Zool. Anz., 1889, p. 314; Bedriaga, Bull. Soc. Nat. Mosc., 1889, p. 306; Boettger, Ber. Senck. Ges., 1890, Protok., p. lxx; Méhely, Zool. Anz., 1890, p. 446; M. Braun, Arch. Ver. Nat. Fr. Mecklenb., xliv, 1891, p. 44; Boulenger, Proc. Zool. Soc., 1891, p. 605, pl. xlv, fig. 2; Westhoff, Jahresb. Westf. Prov. Ver., xx, 1892, p. 51; Méhely, Math. Term. Közl. Budapest, xxv, 1892, p. 29, pls. ii & iv; Douglass, Herp. Baden, p. 42 (1894); Werner, Verh. Zool.-bot. Ges. Wien, xliv, 1894, p. 237, Zool. Anz., 1895, p. 479, and Rept. Amph. Oesterr.-Ung., p. 90 (1897); Dürigen, Deutschl. Amph., p. 448, pl. iii, fig. 3 (1897).

Rana oxyrrhinus, Steenstrup, Ber. 24. Vers. Nat. u. Aerzte, Kiel, 1846, p. 131; Siebold, Arch. f. Nat., 1852, p. 14; Schiff, in Thomas, Ann. Sc. Nat. (4), iv, 1855, p. 368, pl. vii, figs. 5 & 6; Steenstrup, Vid. Meddel., 1869, p. 3, figs.; Sahlertz, Vid. Meddel., 1871, p. 113; Koch, Ber. Senck. Ges., 1872, p. 135; Fatio, Vert. Suisse, iii, p. 345 (1872); Héron-Royer, Bull. Soc. Et. Sc. Angers, xiv, 1885, p. 128; Héron-Royer & Van Bambeke, Arch. Biol., ix, 1889, p. 263.

? Rana temporaria, part., Middendorff, Reise, ii, p. 247, pl. xxvi, fig. 3 (1855).

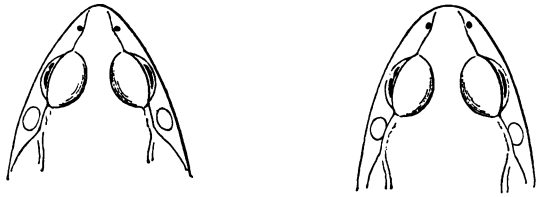
Rana agilis (non Thom.), Wolterstorff, Jahrb. Nat. Ver. Magdeb., 1890, p. 316 (1891).

Vomerine teeth in two oblique series or oval groups just behind the level of the posterior borders of the choanæ.

Rana arvalis.

Head as long as broad or a little broader than long; snout as long as or slightly shorter than the diameter

FIG. 103.



Upper views of heads.

of the orbit, usually more or less acuminate and strongly projecting beyond the mouth, sometimes rounded and blunt, as shown by the above figures representing the two extremes; canthus rostralis distinct; loreal region feebly oblique, grooved; nostril equally distant from the eye and the end of the snout, or a little nearer the former; interorbital space narrow, measuring one-half to two-thirds the width of the upper eyelid, narrower than the space between the nostrils; tympanum very distinct, distant from the eye and measuring one-half to two-thirds its diameter.

Fingers obtuse, first extending beyond second; subarticular tubercles moderate.

The tibio-tarsal articulation reaches the eye or the nostril, rarely as far as the tip of the snout; tibia

FIG. 104.

Lower views of feet, male and female.

shorter than the fore limb, a little longer than the femur, as long as or a little shorter than the foot;

the heels overlap when the limbs are folded. Toes slender, obtuse, one-half to three-fourths webbed, the web more developed in the breeding male, but never reaching beyond the penultimate phalanx of the fourth toe; subarticular tubercles moderately developed; inner metatarsal tubercle very strong, hard, compressed, subcrescentic, measuring one-half to two-thirds the length of the inner toe; no outer metatarsal tubercle.

Skin smooth or with small warts, which may form a chain along each side of the vertebral line; a Λ-shaped glandular ridge usually present between the shoulders; glandular dorso-lateral folds strong, very prominent, narrower than the upper eyelid; these folds slightly converge towards each other behind the supra-temporal folds, the distance between them on the scapular region being one-seventh to one-fifth the length from snout to vent; a glandular fold behind the angle of the mouth. Lower parts smooth, more or less distinctly granulate or areolate on the hinder part of the belly and at the base of the thighs.

Coloration very variable. Greyish, yellowish, reddish, or brown above, nearly uniform or spotted with dark brown or black, or closely spotted and speckled plum-pudding fashion with black; usually a Λ-shaped dark marking between the shoulders; a dark canthal streak, and usually a more or less distinct dark temporal spot; upper lip edged with brown or black, with a light labial streak above, extending from the tip of the snout to the shoulder; females sometimes with a large black lumbar spot; flanks usually largely spotted or marbled with brown or black; dorso-lateral folds usually light, yellowish, pinkish, or golden, often dark-edged; limbs usually with dark cross-bars; a dark streak on the inner side of the arm; hinder side of thighs yellowish, pinkish, or greyish, uniform or with small dark spots. Some specimens are remarkable for the handsome markings of the upper parts; a broad yellowish or pink stripe with straight or wavy borders extends

from the snout to above the vent, and the brown or black spots often run together to form a dark stripe on each side of the light one, and one or two others on each side of the body. Contrary to a statement made by Leydig in 1891, a light spot on the vertex, corresponding to the frontal gland, may be very distinct, as well marked as in any specimen of *Rana temporaria*, and much more than in *R. esculenta* and *R. agilis*.

Lower parts white, often yellow near the groin, immaculate, or the throat and breast spotted with brown or greyish, or with red in the females; in the latter some red spots may be scattered on the belly.

Males distinguished by a shorter body, much stronger fore limbs, a large pad on the inner finger, and a pair of internal vocal sacs. During the breeding season the pad on the inner finger, together with the inner surface of the last phalanx, covered with black horny spinules as in *R. temporaria*, and the skin likewise swollen with lymph, often assuming a uniform pale blue or bluish colour on the upper surfaces and on the throat. The web between the toes is then much developed, with rectilinear or even convex outline, and reaches the tips of the third and fifth toes. Females during the breeding season develop pearl-like excrescences on the sides and limbs, which are, however, less developed than in *R. temporaria*.

The remarkable colour-dimorphism exhibited by this species, an exact parallel of that observed in *Discoglossus pictus*, often occurs promiscuously, as, for instance, near Berlin, where I have found the two forms in nearly equal abundance in the same localities. But this is not always the case, for Westhoff has observed in Westphalia the striped form to be alone present in certain bogs, whilst other drier stations yield exclusively or principally the spotted form. The latter is also the only one that has yet been found in Norway, and is by far the more abundant in Denmark, whilst in Sweden both seem to be about equally represented.

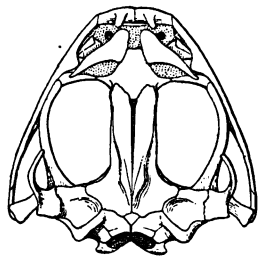
MEASUREMENTS (in millimetres).

	♂				♀			
	1.	2.	3.	4.	5.	6.	7.	8.
From snout to vent	58	58	64	73	59	60	62	60
Length of head	18	18	19	21	17	17	18	18
Width of head	20	20	21	24	19	20	21	20
Diameter of eye	5	6	6	7	5	5·5	5·5	5·5
Interorbital width	2·5	3	3	3·5	2·5	3	2·5	2·5
From eye to nostril	4	3·5	4	4·5	3·5	3·5	3	3·5
„ to end of snout	8	8	8	10	8	7	8	8
Diameter of tympanum	3·5	3	3·5	4	3·5	3	3	3·5
Fore limb	36	35	40	44	29	31	31	32
Hind limb	105	97	111	132	88	89	90	97
Tibia	31	29	36	40	27	27	27	30
Foot	36	32	37	44	29	30	32	33
Inner toe (from tubercle)	6	6	6	8	5	5·5	5	6
Inner metatarsal tubercle	3·5	3·5	4	4	3	3·5	4	3·5

1. Seeland: Lütken.
2, 6. Berlin: Boulenger.
3. Neudorf, nr. Basle: F. Müller.
4. Karlovac, Sclavonia: Fritsch.
5. Hval Oerne, Norway: Collett.
7. Copenhagen: Héron-Royer.
8. Szamos-Ujvar, Transylvania: Méhely.

SKELETON.—Skull intermediate between *R. esculenta* and *R. temporaria*. Fronto-parietals convex, about thrice as long as broad, sometimes separated from

FIG. 105.



Upper view of skull.

each other along the median line; nasals widely separated from each other, oblique, with straight or slightly concave posterior border; upper surface of ethmoid obtusely pointed anteriorly; zygomatic pro-

cess of squamosal as long as the posterior. Occipital condyles entirely behind the articular extremities of the upper jaw.

Diapophyses of dorsal vertebræ more unequal in length than in *R. esculenta*, the second once and a half to once and two-thirds as long as the last three.

Tibia longer than the femur, nearly twice as long as the tarsus. Terminal phalanges expanded at the end, somewhat anchor-shaped. A single large bone to the præhallux. The sesamoid bone on the inner side of the proximal extremity of the tarsus much larger than in *R. esculenta*.

MEASUREMENTS OF SKELETON (in millimetres).

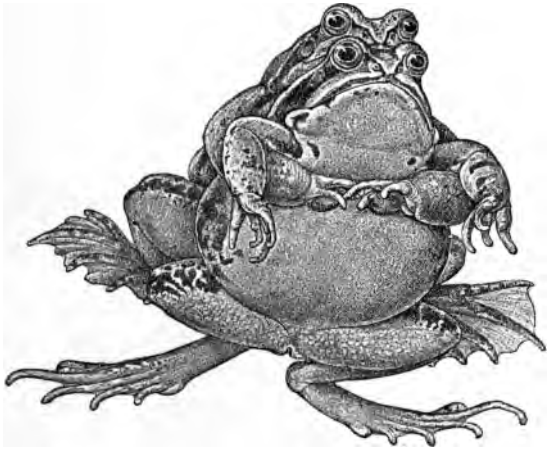
	♂		♀
Length of skull	16	...	16
Width of skull	16	...	17
Least interorbital width	3	...	3
Dorsal vertebral column	18	...	19
Urostyle	17	...	17
Humerus	16	...	14
Radius-ulna	10	...	8
Manus	12	...	13
Pelvis	22	...	22
Femur	24	...	23
Tibia	27	...	25
Tarsus	13	...	12
Pes	30	...	28

HABITS.—*Rana arvalis* pairs in March or April, together with or a week or a fortnight later than *R. temporaria*, and after the breeding season leads a terrestrial existence, being found in fields, meadows, and bogs, in company with the common frog, although as a rule more partial to damp localities. Numbers of males hibernate under water. The voice is very different from that of *R. temporaria*, and much resembles that of *R. agilis;* it may be rendered by *co, co, co*, and has been compared to the sound of air escaping from a bottle held under water. No foresight is exercised in the selection of a site for the deposition of the ova, which are often doomed through the drying up of ditches or shallow puddles of rain

water. In Germany the larvæ transform between the middle of June and the beginning of August.

In spite of what the great development of the metatarsal tubercle would seem to indicate, this frog cannot be said to show any special disposition to burrow; and as far as my experience goes, from having repeatedly kept individuals in confinement, it does not seem in any way to excel the common species in this respect. The physiological significance of the character is no more obvious here than in those varieties of *Rana esculenta* in which the metatarsal tubercle attains so great a development, without yet the frogs differing appreciably in their mode of life from their spurless allies.

FIG. 106.



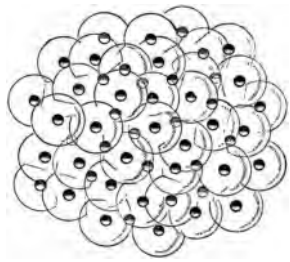
Male and female pairing.

Hybrids between this species and *R. temporaria* have been obtained with great difficulty by Born, the latter species acting as the male, whilst all attempts at reciprocal crossing have hitherto failed.

EGGS.—Intermediate in appearance between those of *R. esculenta* and *R. temporaria*, the vitellus measuring 1½ to 2 mm. in diameter, and the mucilaginous envelop,

which dissolves much more rapidly than in *R. temporaria*, 7 or 8. These eggs number from 1000 to 2000 according to Héron-Royer; I have counted 1829, 1518, and 1029; they form one, or rarely two large balls, which do not float as in *R. temporaria*. The vitelline sphere is black above and whitish below; the white may be restricted to one-third of the surface

FIG. 107.



or extend over nearly the whole of the lower half; I have, however, observed egg-masses of this species in which the white lower spot was much reduced, nothing but the smaller size distinguishing them from those of *R. temporaria*. The embryo on emerging is blackish-brown, and provided with branched external gills, which are smaller than in *R. temporaria* and less strongly pigmented.

TADPOLE (Pl. III, fig. 2).—Intermediate between *R. esculenta* and *R. temporaria*. In its labial dentition it agrees with the former, the series of teeth being usually $\frac{2}{3}$, sometimes $\frac{3}{3}$, when a third very short series is present on each side of the upper lip. Beak whitish, narrowly edged with black. Interocular space about once and a half the distance between the nostrils, which equals or slightly exceeds the width of the mouth. Tail pointed, rarely somewhat obtuse, once and two-thirds to twice the length of the body, its depth about one-third its length; depth of the muscular part not quite half the greatest total depth. Lines of muciferous crypts distinct, disposed as in *R. agilis*.

Brown above, with metallic spots; caudal crests greyish-white, with small brown spots and golden dots on the anterior half of the upper crest; sometimes a series of large brown spots on the upper edge of the tail, or a linear series of small golden spots along the upper and lower crests; belly greyish with golden dots.

Total length 43 mm.; body 16; width of body 10; tail 27; depth of tail 9.

HABITAT.—*Rana arvalis* is often described as a boreal species, but this is quite incorrect. Its northern range extends but slightly beyond that of *R. esculenta*, and stops short by 10° of that of *R. temporaria*. It is only found on the south-eastern coast of Norway, where it is local and rare; in Sweden it does not reach much further north than Upsala, and in Russia not beyond South-eastern Finland. It is really an Eastern species, which, except in the south, has much the same range as *Bufo viridis*, being generally distributed in the eastern parts of Central Europe, and becoming more and more local towards the Rhine, on the left side of which it is as yet only known from a small district in Alsatia and Switzerland. The broken, spot-like character of its distribution towards the west, and the nature of the localities in which it usually occurs, as sphagnum bogs, fens, neglected meadows, &c., clearly point to its being, in those parts, in process of gradual extinction, a relic of a former period, the conditions of which are fast disappearing through human agency except in the mountains, which this species nowhere ascends beyond 2000 feet. Were *R. arvalis* a boreal form, as stated by some authors, its range in Central Europe and its absence from the mountains would be not exactly unparalleled, but very much more difficult of explanation.

In Europe the species occurs from the Northern and Middle Oural to Holland (near Apeldoorn), several localities east of the Rhine (Elberfeld, Siegburg near

Bonn, Wiesbaden, Rheingau, Mayence, Offenbach, Mannheim, Karlsruhe, Freiburg), and a few west of the Rhine (neighbourhood of Kreuznach, Neudorf in Alsatia, and Basle in Switzerland). It is generally distributed in Poland, Silesia, Prussia, Mecklenburg, Schleswig-Holstein, Denmark, Oland, Gothland Island, and Sweden, as far north as Upsala, but only found in two localities in Southern Norway (Hof in Jarlsberg, and Hval Oerne). It is more local in the province of Saxony, the kingdom of Saxony (Leipzig and Dresden), and in Austria-Hungary, where it is on record from the plains of Transylvania, Budapest, Pressburg, Franz Josefsland, and Marchfeld in Lower Austria, Karlovac in Sclavonia, Agram, and Fiume in Istria.

Its distribution in Asia is not yet made out with anything like precision, owing to the fact that it has so long been confounded with *R. temporaria*, and of late with *R. camerani*. I have examined specimens from Sarai Gor, on the Ob, the valley of Buchtarma, Altai, and the Kirghiz Steppes, and Bedriaga records the species from the Karakali Mountains. The specimens from Sultania in Persia, and Lake Gokcha, referred to this species by de Filippi, belong to the following, *R. camerani*, as I am informed by my friend Dr. de Bedriaga, who has examined the types at my request.

The three specimens figured on Pl. XVIII are from Magdeburg, received from my obliging correspondent Mr. W. Wolterstorff. The right-hand figure represents a male in breeding costume, the two others are taken from females.

15. RANA CAMERANI.

(Plate XIX.)

Rana oxyrhina (non Steenstrup), Filippi, Viagg. Pers., p. 357 (1865).
Rana camerani, Boulenger, Bull. Soc. Zool. France, 1886, p. 597; Boettger, Ber. Senck. Ges., 1892, p. 134; Boulenger, Proc. Zool. Soc., 1896, p. 550, pl. xxi. fig. 1.
Rana holtzi, Werner, Zool. Anz., 1898, p. 222.

Vomerine teeth in two small oblique groups close together, just behind the level of the posterior borders of the choanæ.

Head a little broader than long; snout as long as the diameter of the orbit, more or less acuminate and strongly projecting beyond the mouth; canthus rostralis distinct; loreal region very oblique, grooved; nostril equally distant from the eye and the end of the snout; interorbital space narrow, measuring one-half to two-thirds the width of the upper eyelid, narrower than the distance between the nostrils; tympanum very distinct, distant from the eye, and measuring about half its diameter.

Fingers obtuse, first and second equal, or first extending very slightly beyond second; subarticular tubercles moderate.

The tibio-tarsal articulation reaches the eye or the nostril; tibia as long as or slightly shorter than the fore limb, a little longer than the femur, as long as or slightly shorter than the foot; the heels overlap when the limbs are folded. Toes slender, obtuse, two-thirds to three-fourths webbed; subarticular tubercles moderately developed; inner metatarsal tubercle soft, oval, measuring two-fifths to one-half the length of the inner toe; a small outer metatarsal tubercle at the base of the fourth toe.

Skin smooth or with small warts; glandular dorso-lateral folds strong and prominent, much narrower than the upper eyelid; these folds nearly straight,

Rana camerani.

or slightly converging towards each other behind the supra-temporal folds; the distance between them on the scapular region equals one-sixth to two-ninths the length from snout to vent; a glandular fold behind the angles of the mouth. Lower parts smooth, granulate under the thighs.

Coloration very variable. Yellowish or brown above, variously spotted or dotted with dark brown or black; a dark brown or black canthal streak and a larger temporal spot; upper lip edged with brown or black, with a light labial streak above from the tip of the snout to the shoulder; some specimens with a yellow vertebral stripe between two dark ones; flanks with large dark spots or marblings; limbs with regular dark bars. The light spot indicative of the presence of the frontal gland is usually very distinct, more so than is the rule in the other species of *Rana*. Lower parts white, unspotted, or with small brown spots on the sides of the throat.

MEASUREMENTS (in millimetres).

	♂			♀
	1.	2.	3.	4.
From snout to vent	59	45	70	63
Length of head	17	15	21	18
Width of head	20	16	24	19
Diameter of eye	5·5	5	6	6
Interorbital width	3	2·5	3	3
From eye to nostril	4	3	4·5	4
„ end of snout	8	6·5	10	8
Diameter of tympanum	3	2·5	3·5	3·5
Fore limb	35	25	40	37
Hind limb	98	74	121	102
Tibia	32	24	40	34
Foot	32	24	42	34
Inner toe (from tubercle)	7	5	7	7
Inner metatarsal tubercle	3	2	3	3

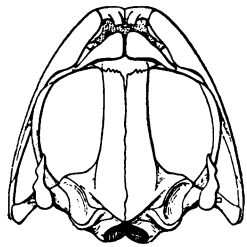
1. L. Talizhuri.
2. Gilli, L. Gokcha.
3. Kasikoporan.
4. Kurush.

SKELETON.—Very similar to that of *R. arvalis*, and in some respects approaching *R. esculenta*. Fronto-parietals convex and grooved along the median suture, nearly thrice as long as broad; ethmoid truncate

anteriorly, nearly entirely covered by the fronto-parietals; nasals narrowly separated from each other, with very slightly concave posterior border; zygomatic process of squamosal as long as the posterior process.

Tibia considerably longer than the femur, more than twice as long as the tarsus.

FIG. 108.



Upper view of skull.

MEASUREMENTS OF SKELETON (in millimetres).

	♂
Length of skull	13
Width of skull	13
Least interorbital width	2·5
Dorsal vertebral column	13
Urostyle	14
Humerus	12
Radius-ulna	8
Manus	11
Pelvis	18
Femur	21
Tibia	25
Tarsus	11
Pes	24

This species is very closely allied to *Rana arvalis*, which it resembles in physiognomy and coloration, but from which it may be easily distinguished by the soft and feebly prominent inner metatarsal tubercle.

Males have internal vocal sacs, strong fore limbs, and a large undivided pad on the inner finger.

Nothing is known of the habits and development.

HABITAT.—This mountain frog was first discovered by de Filippi about Lake Gokcha in Transcaucasia,

Rana temporaria

and at Sultania in N.W. Persia, but confounded with *R. arvalis*. I described it as a new species from specimens obtained by Dr. Oscar Schneider at Lake Talizhuri, 8000 feet, and at Achalkalki, in the Caucasus. It has since been re-discovered in various parts of Transcaucasia and Armenia, and I have recently received from Dr. Radde a specimen captured in Europe, at Kurush, Daghestan, at an altitude of 8000 feet. A young specimen from Albistan, which I had previously referred to *R. arvalis*, also belongs to this species, and others likewise from the Cilician Taurus (8000 feet) have been described as *R. holtzi*.

The three specimens, male and half-grown, figured on Pl. XIX, are from Kasikoporan, 6500 feet, in Western Armenia, presented by Dr. G. Radde.

16. Rana temporaria.*

(Plates XX and XXI.)

Rösel, Hist. Ran., p. 1, pls. i—viii (1758).

Rana temporaria, part., Linnæus, Syst. Nat., p. 357 (1766); Daudin, Hist. Rain. Gren. Crap., p. 46 (1803), and Hist. Rept., viii, p. 94 (1803); Duméril & Bibron, Erp. Gén., viii, p. 358 (1841); Middendorff, Reise, ii, p. 247, pl. xxvi, fig. 1 (1853); Günther, Cat. Batr. Sal., p. 16 (1858); Schreiber, Herp. Eur., p. 125 (1875); De Betta, Atti Ist. Venet. (6), iv, 1885, p. 45.

Rana muta, Laurenti, Syn. Rept., p. 30 (1768); Camerano, Mem. Acc. Torin. (2), xxxv, 1883, p. 257, pl. i, figs. 9 & 10; Borelli, Boll. Mus. Torin., i, 1886, No. 14; Bedriaga, Bull. Soc. Nat. Mosc., 1889, p. 278; Dürigen, Deutschl. Amph., p. 437, pl. iii, fig. 4 (1897).

Rana rufa, Lacépède, Quadr. Ov., i, Syn. Méth. & p. 528 (1788).

Rana temporaria, Bonnaterre, Tabl. Encycl. Méth., Erp., p. 3 (1789); Schneider, Hist. Amph., i, p. 113 (1799); Gravenhorst, Delic. Mus. Vratisl., p. 38 (1829); Bonaparte, Icon.

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* I use the name *temporaria* for the present species, although the diagnosis in the 'Fauna Suecica' was evidently drawn up from *R. arvalis*, because Linnæus confounded the two species, both of which are common in Sweden, as is perfectly clear from the synonymy given in the 'Systema Naturæ.' The first author who split up the Linnean species, Nilsson, elected to retain the old name for the present one, which may therefore bear it in accordance with the law of priority.

Faun. Ital., Rett. Anf. (1837); Bell, Brit. Rept., p. 84, fig. (1839); Nilsson, Skand. Faun., Amf., p. 78 (1842); Bell, Brit. Rept., 2nd ed., p. 89, fig. (1849); C. Koch, Ber. Senck. Ges., 1872, p. 135; Fatio, Vert. Suisse, iii, p. 321 (1872); De Betta, Faun. Ital., Rett. Anf., p. 64 (1874); Lessona, Atti Acc. Lincei, Mem. Cl. Sc. fis., i, 1877, p. 1068, pl. ii; Boulenger, Cat. Batr. Ecaud., p. 44 (1882), Bull. Soc. Zool. France, 1886, p. 595, and Proc. Zool. Soc., 1891, p. 605, pl. xlv, fig. 3; Scharff, Irish Nat., ii, 1893, p. 1; Boulenger, Ann. Scott. N. H., 1893, p. 202; W. Evans, Proc. Phys. Soc. Edinb., xii, 1894, p. 509; Werner, Rept. Amph. Oesterr., p. 91 (1897).

Rana atra, Bonnaterre, l. c., p. 9.

Rana alpina, Gmelin, Syst. Nat., i, p. 1058 (1789); Risso, Hist. Nat. Eur. mérid., iii, p. 93 (1826); Bonaparte, op. cit. (1839).

Rana flaviventris, Millet, Faune Maine-et-Loire, ii, p. 663 (1828).

Rana cruenta, Pallas, Zoogr. Ross.-As., iii, p. 12 (1831).

Rana scotica, Bell, l. c., p. 102.

Rana platyrrhinus, Steenstrup, Amtl. Ber. 24. Vers. Naturf. Kiel, 1846, p. 131, and Vid. Meddel., 1869, p. 3, figs.; Collin, Naturh. Tidsskr. (3), vi, 1869, p. 299; Sahlertz, Vid. Meddel., 1871, p. 111; Collett, Vid Selsk. Forh. Christ., 1878, No. 3, p. 6.

Rana temporaria, var. *canigonica*, Boubée, Bull. H. N. France, i, 1833, No. 2, p. 12.

Rana fusca, Thomas, Ann. Sc. Nat. (4), iv, 1855, p. 365; De l'Isle, Ann. Sc. Nat. (5), xvii, 1873, No. 3, p. 2; Leydig, An. Batr., p. 116 (1877); Collin de Plancy, Bull. Soc. Sc. Semur, 1877, p. 41; Boulenger, Bull. Soc. Zool. France, 1879, p. 164, and 1880, p. 207; Héron-Royer, Bull. Soc. Et. Sc. Angers (2), xiv, 1885, p. 119; Héron-Royer & Van Bambeke, Arch. Biol., ix, 1889, p. 260; Méhely, Beitr. Mon. Kronstadt, Herp., p. 56 (1892), and Math. Term. Közl. Budapest, xxv, 1892, p. 8, pls. i & iv; Douglass, Herp. Baden, p. 40 (1894).

Rana temporaria, vars. *obtusirostris*, *acutirostris*, Fatio. l. c.

Rana dybowskii, Günther, Ann. & Mag. N. H. (4), xvii, 1876, p. 387.

Rana fusca honnorati, Héron-Royer, Bull. Ac. Belg. (3), i, 1881, p. 139, pl.

Rana fusca, var. *longipes*, F. Müller, Verh. Nat. Ges. Basel, vii, 1885, p. 670.

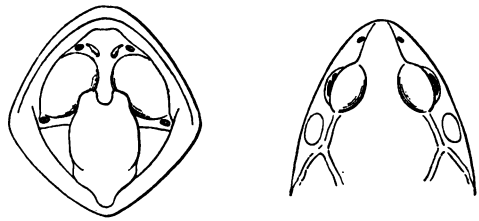
Rana temporaria parvipalmata, Seoane, The Zool., 1885, p. 169, fig.

Vomerine teeth in two feeble, oblique, narrow groups, on a level with or just behind the posterior border of the choanæ.

Head broader than long; snout as long as or a little shorter than the diameter of the orbit, usually broadly rounded and scarcely projecting beyond the mouth, rarely obtusely acuminate; canthus rostralis distinct; loreal region feebly oblique, feebly grooved; nostril equally distant from the eye and the end of the snout, or a little nearer the former; interorbital

space broad, flat, usually as broad as or a little narrower than the upper eyelid, sometimes, however, only two-thirds the width of the latter, as broad as or a little narrower than the distance between the nostrils; tympanum very distinct, distant from the eye, measuring one-half to two-thirds, rarely three-fourths its diameter.

Fig. 109.



Open mouth and upper view of head.

Fingers obtuse, first extending slightly beyond second; subarticular tubercles moderate.

The tibio-tarsal articulation reaches the tympanum, the eye, or the nostril, very rarely the tip of the snout; tibia shorter than the fore limb, a little longer than the femur, as long as or a little shorter than the foot; the heels overlap when the limbs are folded. In some specimens from Spain the tibia is but very slightly shorter than the fore limb. Toes slender, two-thirds or almost entirely webbed, the terminal phalanx of the fourth toe, however, always free; toes one-half to two-thirds webbed in the Spanish var. *parvipalmata;* subarticular tubercles moderately developed; inner metatarsal tubercle feeble, soft, roundish or oval, measuring less than one-half, usually about one-third, the length of the inner toe; a small and rather indistinct tubercle rarely present at the base of the fourth toe.

Skin smooth or with irregular smooth warts; a Λ-shaped glandular ridge usually present between the shoulders; glandular dorso-lateral folds narrow or moderately broad, moderately prominent, converging

towards each other on the scapular region, where they are separated by a space equalling one-seventh to one-sixth, rarely one-fifth, the length from snout to vent; a glandular fold behind the angle of the mouth, and another from the eye to the shoulder; females with the sides of the head and body, the pelvic region, and the upper surface of the leg and tarsus studded with pearl-like granules, which are more developed during the breeding season. Lower parts smooth, the posterior half of the thighs granular.

Few species vary so much in coloration as does the common frog; out of a large number it is rare to find two perfectly alike in their markings. The ground colour of the upper parts may be grey, brown, rufous, pink, or yellow, usually spotted, speckled, or marbled with darker; the spots are usually dark brown, sometimes orange or bright brick-red; black blotches resembling ink-spots may be scattered on the back, or so crowded together as to produce a plum-pudding appearance; sometimes these black spots run together, and the upper parts are nearly entirely black. The more characteristic markings, viz. a large blotch on the temporal region, a streak on the inner side of the arm, a Λ-shaped figure between the shoulders, and bands across the limbs, may be more or less well defined, or entirely absent; the bands on the limbs, if present, may be numerous and close together, or few and irregular. A broad, light, dark-edged vertebral stripe is sometimes, though rarely, present; in one specimen, a female from Banffshire, it is as well defined as in the striped specimens of *Rana arvalis*. The flanks nearly always bear large spots or marblings. The canthus rostralis is usually indicated by a dark line, and a light streak extends on each side of the upper lip from below the eye to a little beyond the angle of the jaws.

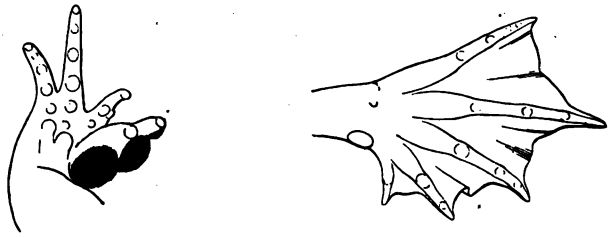
The lower parts in the males are white or pale yellow, bluish or lilac on the throat, usually spotted, marbled, or speckled with brown or grey. In the

females they vary from pale yellow to orange, usually spotted or marked with brown, orange, or red. There are, however, specimens in which the belly is unspotted, more particularly those from Spain.

Iris golden, sometimes obscured with brown vermiculations.

Males differ from females in the stronger, more muscular fore limbs, which acquire an extraordinary

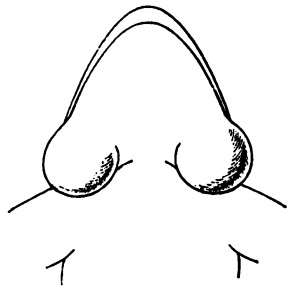
FIG. 110.



Hand and foot of breeding male (lower views).

development during the pairing season; the pad-like swelling of the inner side of the first finger, which becomes covered with black horny spinules during the pairing season; the greater development of the

FIG. 111.



Gular region of breeding male, with inflated vocal sacs.

web between the toes; and the presence of a pair of internal vocal sacs, situated at the sides of the throat.

In breeding males the skin acquires a spongy ap-

pearance through swelling with lymph, which produces a cloudy, bluish tinge on the upper parts and on the throat, the latter region being sometimes quite blue, sharply contrasting with the white or pale yellow of the abdomen.

MEASUREMENTS (in millimetres).

	♂				♀			
	1.	2.	3.	4.	5.	6.	7.	8.
From snout to vent	80	84	72	59	95	80	97	60
Head	22	23	19	16	23	22	25	17
Width of head	27	29	25	19	31	29	34	21
Diameter of eye	7	7·5	7	6	8	7	8·5	6
Interorbital width	4	4	3·5	3	4·5	5	5	3
From eye to nostril	4·5	3·5	3·5	3	4·5	5	5	3·5
From eye to end of snout	10	11	8	7·5	10	10	11	8
Tympanum	4	5	3	4	5	5·5	6	4
From eye to tympanum	2·5	2·5	2·5	2	3	2·5	3	2
Fore limb	47	49	45	35	52	47	51	37
Hind limb	122	127	121	95	140	130	141	102
Tibia	40	41	38	29	44	43	45	31
Foot	40	45	40	33	48	43	45	35
Inner toe	9	11	10	6·5	11	10	9·5	7
Inner metatarsal tubercle	4	4	3	2·5	4	3·5	4·5	2

1, 5. Canisbay: Anderson.
2. Dovre Mts., Norway: Collett.
3. Cassel: Norman.
4, 8. Corunna: Seoane.
6. Cuneo: Peracca.
7. Tömös, Hungary: Méhely.

VARIATIONS.—Apart from the description of individual variations, which, as we have seen, are very considerable in this species, attempts have been made to distinguish a broad-snouted and a sharp-snouted variety, to which Fatio has given the names of *brevirostris* and *acutirostris*. This distinction cannot be upheld, as we find the two forms occurring promiscuously, and the prognathism affecting only young or half-grown specimens. The only form which appears to be entitled to varietal distinction is the Spanish var. *parvipalmata*, which is constantly distinguished by a shorter web, as we have seen above,

1.

Rana temporaria.

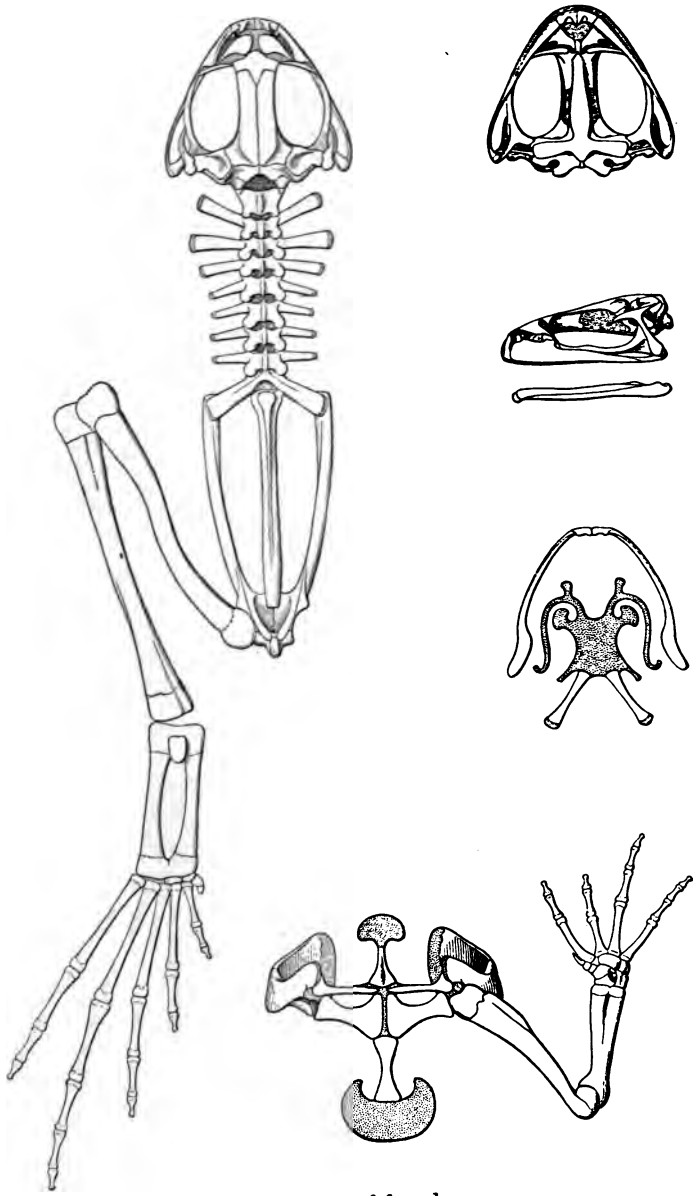
and a somewhat more slender habit, resulting in a certain resemblance to *Rana agilis*, with which it also often agrees in the absence of any but small red spots on the belly.

The var. *bosniensis*, recently established by Werner ('Rept. Amph. Oesterr.,' p. 92) on a single male specimen from Travnik, Bosnia, is, in my opinion, not entitled to stand. Thanks to Dr. Werner's courtesy, I have examined the type, and find the pelvis to be broken, which accounts for the shortness of the body; hence the tibio-tarsal articulation of the hind limb reaches a little beyond the tip of the snout. The specimen measures 71 mm. from snout to vent; fore limb 49 mm.; tibia 42 mm.

The var. *longipes* of F. Müller—of which the type, from Oberweiler, between Mullheim and Badenweiler, Baden, has been entrusted to me by Mr. Schenkel, the curator of the Basle Museum—is based on a somewhat long-legged individual of the common frog, in which the tibio-tarsal articulation reaches exactly the tip of the snout,—not beyond, as stated in the original description. The specimen, a female, measures 55 mm. from snout to vent; fore limb 36 mm.; tibia 30 mm. C. Koch's var. *gracilis* is no doubt founded on similar examples, which seem to predominate on the southern slopes of the Alps, and have been described by Héron-Royer as a distinct sub-species, *Rana fusca honnorati*, from the Basses-Alpes. The larval characters adduced in support of the establishment of the latter form have since proved to be as unreliable as those derived from the perfect animal.

Skeleton.—Fronto-parietals broad and flat, about twice and one-third to twice and three-fourths as long as broad. Nasals small, separated from each other, with strongly concave posterior border. Upper part of ethmoid rounded or obtusely pointed in front. Zygomatic process of squamosal shorter than the posterior process. Occipital condyles behind the line connecting the articular extremities of the upper jaw.

FIG. 112.



Skeleton of female.

Vertebral column twice and a half to three times as long as the skull. Second diapophysis once and a half as long as the seventh, which is considerably shorter than the sacral; latter directed backwards. Tibia a little longer than the femur, as long as or a little shorter than the pes; a large sesamoid bone below the tibio-tarsal articulation. Tarsus nearly half as long as the tibia. Two bones to the præpollex and two or three to the præhallux. Terminal phalanges feebly expanded at the end.

The skeleton here figured is that of a female from the Alps of Piedmont, in which the hind limb is a little more elongate in proportion than in British examples.

MEASUREMENTS OF SKELETON (in millimetres).

	♂		♀
Length of skull	17	...	21
Width of skull	19	...	24
Least interorbital width	3·5	...	4
Dorsal vertebral column	21	...	27
Urostyle	22	...	28
Humerus	20	...	23
Radius-ulna	13	...	15
Manus	17	...	20
Pelvis	27	...	30
Femur	31	...	39
Tibia	35	...	43
Tarsus	16	...	20
Pes	38	...	43

HABITS.—*Rana temporaria* must be regarded, on the whole, as a terrestrial frog, although less strictly so than *R. arvalis* and *R. agilis*. It is by no means unusual to find specimens in ponds or pools throughout the summer. The majority, however, spend the greater part of their active life on land, in fields, gardens, meadows, and woods. Many males hibernate under water. The breeding season falls earlier than in any other species, in January and February in the south, in March and April in the north. In the exceptional year 1894 the common frog began to spawn,

near London, on the 16th February; last year (1897) on the 20th of the same month: as a rule, the spawning time varies with us from the beginning of March to the beginning of April, according to the mildness of the season, whilst in Devonshire and Cornwall it may begin as early as the end of January. The individuals then congregate in large numbers in ponds, pools, ditches, or slow-running brooks, the males clinging to the females by clasping them under the arms, the hands joining on the breast, at the same time uttering their dull croak, *grook, grook*, which, unlike the edible frog's, is produced mostly under water. If the weather turns cold after pairing has set in, the embrace may last for many days; the genesic fury of the males is such that nothing will induce them to release their hold. But as males in this species are not in greater numbers than the other sex, we seldom witness those fights which are so frequent in the equally ardent *Bufo vulgaris*. Nevertheless they also often make mistakes, and clasp female toads, or *Pelobates*, frequently causing the death of the latter by fracture of the pectoral girdle, that Batrachian, as we have described above, being, in legitimate unions, seized round the waist, not under the arms. That, in the same way, common frogs and toads are injurious to slow-moving pond fishes, such as carp, to which they cling by poking the hands into the eyes of the fish, was noticed by Pennant in the last century, and has since been verified by numerous observers.

The eggs are expelled very suddenly, and the large clumps are afterwards seen floating on the surface, many together, these frogs usually selecting the same part of a pond or ditch for spawning. Two or three weeks elapse, as a rule, before the liberation of the embryo, and the young are usually able to leave the water in May or beginning of June, except in the extreme north and high up in the mountains, where, the spawning season being necessarily much retarded,

tadpoles are still to be found in August, and are even sometimes compelled to hibernate in that condition.

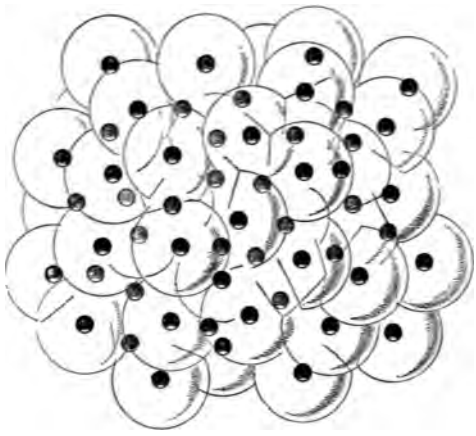
Many observers who have kept pairing frogs of this species in confinement have been disappointed at finding the eggs laid under these conditions to be unfertilised, this being often the case when single pairs are confined in jars, and apparently due to the male not emitting his fecundating fluid at the right moment. Fischer-Sigwart has recently attempted to explain this fact by suggesting that the males fecundate the eggs some time after they are laid and after the release of the females from embrace. I cannot accept this explanation, because I have observed, in practising artificial insemination, that the spermatozoa appear to be unable to penetrate the eggs after the mucilaginous capsules have become swollen out with water, which takes place very rapidly after deposition. In order to fully satisfy my mind on this point, I made this spring (March 22nd) the following experiment.

At 11 a.m. I pressed into two dishes filled with water from the supply-tap a few eggs (about fifty in each dish) from a female held in embrace. The pair were then separated and kept dry until 2 p.m., when the male was killed and the fluid removed from the vesicula seminis, whilst two further small lots of eggs were pressed out of the female into the dishes in which lay those previously obtained, with their capsules now considerably inflated. I then poured the seminal fluid, diluted in a wineglassful of water, over the four clumps of eggs. The result was the same in both dishes: the eggs laid at 11 a.m. and fecundated at 2 p.m. did not develop (with one and two exceptions respectively), whilst the great majority of the others underwent their normal evolution.

Eggs.—Vitellus measuring 2 to 3 mm. in diameter, black, with a small white or grey spot on the lower pole; mucilaginous envelop measuring 8 to 10 mm. in diameter. The eggs form one or two large balls,

which float on the water.* The number of eggs varies according to the size of the female; L. Greening

FIG. 113.



has counted from 1500 to 2500, and Héron-Royer from 2856 to 4005. Greening's results agree better with my own, as I have counted 1155, 1188, 1584, 1744, and 2044. The embryo, on liberation, is of a dark brown, nearly black, with a well-developed tail, and dark brown, branched external gills, which soon acquire a large size.

TADPOLE (Pl. III, fig. 3).—Length of body once and a half to once and two-thirds its width, one-half to two-thirds the length of the tail. Nostrils equally distant from the eyes and the end of the snout, or a little nearer the latter.

Eyes on the upper surface, a little nearer the end of the snout than the spiraculum; the distance between the eyes about once and a half the distance between

* Dr. Ridewood showed me in March, 1897, a mass of eggs that had been laid by a moderate-sized frog. These eggs were exceptionally small, the vitellus measuring rather less than 2 mm., and some of them formed a regular string, in a single file, 4 cm. in length, closely resembling the eggs of a toad. I have preserved a portion of these abnormal eggs in spirit, and they are now in the collection of the British Museum.

the nostrils, and a little greater than the width of the mouth. Spiraculum directed backwards and slightly upwards, nearly equally distant from the end of the snout and from the anus, visible from above and from below. Anus opening on the right side, close to the lower edge of the subcaudal crest. Tail three to four times as long as deep, ending in an obtuse point; upper crest convex, not or but slightly deeper than the lower, not extending far upon the back; the depth of the muscular part, at its base, about one-third the greatest total depth.

Beak broadly edged with black. Sides and lower edge of the lip bordered with papillæ; upper lip with a long series of teeth, followed on each side by two or three series which are widely separated from their fellows on the other side, and gradually decrease in length; four series of teeth in the lower lip, the fourth or inner widely interrupted in the middle, the first or outer at least two-thirds the length of the second.

Muciferous crypts very indistinct.

Brown to blackish above, with metallic dots; caudal crests greyish, uniform or dotted or powdered with brown, with or without small golden spots; belly grey or blackish, with metallic dots or spots.

Total length, 45 mm.; body, 15; width of body, 10; tail, 30; depth of tail, 9. These dimensions are taken from one of many large specimens obtained at Anseremme, Belgium, at the end of April, 1894.

Habitat.—*Rana temporaria* is a Northern species, reaching the extreme north of Scandinavia and Lapland. In Northern and Central Europe it is equally common in the plain and in the mountains, up to the limit of perpetual snow; whilst in the south it is confined to the mountains, reaching an altitude of 7200 feet in the Pyrenees and 10,000 feet in the Italian Alps. It is absent from the plain of France south of 46°, but reappears on the Pyrenees and in North-western Spain, where it is found both at sea level and in the mountains. It appears to be absent

from the Italian peninsula, and to the east of the Adriatic it has not been recorded from further south than the mountains of Bosnia. In Transylvania its occurrence is restricted to the hills and mountains, its place being taken in the plains by *R. arvalis* and *R. agilis*. It is found not only all over Great Britain, but also in Ireland, where it is much more common on the west than on the east coast, and flourishes in the mountains. Its range in Asia is an extensive one, stretching from the northern and middle Oural and the Kirghiz steppes to the Stannovoi Mountains, Sachalien Island, Mongolia, Manchuria, and Yesso, being replaced further south in Eastern Asia by *Rana amurensis*, *R. martensii*, and *R. japonica*.

The male and two females figured on Pl. XX are from the environs of London, and give some idea of the great amount of individual variation in coloration to be observed in this species. Other variations in the markings are represented on Pl. XXI. Fig. 1 represents a male from Dunphail, Morayshire, presented by Mr. W. R. Ogilvie Grant, remarkable for its unusually short snout and its well-marked light vertebral stripe, similar to that of the so-called var. *striata* of *Rana arvalis*. Fig. 2 is taken from a young specimen from Hanover, presented by the late Dr. J. E. Gray. Fig. 3 from a female with remarkably pointed snout, sent from Breslau by Prof. G. Born; a var. *acutirostris*, Fatio, has been founded on such specimens, which appear to have occasionally given rise to erroneous reports on the occurrence of *R. agilis* in Germany. Fig. 4 from one of the types of Seoane's var. *parvipalmata* from Galicia, Spain.

Rana arvea

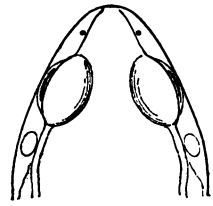
17. Rana græca.

(Plate XXII.)

Rana latastei (non Blgr.), Boettger, Sitzb. Ak. Berl., 1888, p. 148.
Rana latastii, part., Bedriaga, Bull. Soc. Nat. Moscou, 1889, p. 338.
Rana græca, Boulenger, Ann. & Mag. N. H. (6), viii, 1891, p. 346, fig. 1, and Proc. Zool. Soc., 1891, p. 607, pl. xlv, fig. 4; Werner, Zool. Anz., 1897, p. 66; Peracca, Boll. Mus. Torin., xii, 1897, No. 286.

Vomerine teeth in two small oblique series, extending behind the level of the choanæ, originating between the posterior borders of the latter.

Fig. 114.



Upper view of head.

Head a little broader than long, moderately depressed. Snout very short, rounded, not at all prominent, as long as or shorter than the diameter of the orbit; eye smaller than in *R. latastii* and *R. agilis*, less prominent; canthus rostralis distinct; loreal region even less oblique than in *R. temporaria* and *R. iberica*, distinctly concave; nostril equidistant from the eye and the end of the snout, or a little nearer the latter; the distance between the nostrils greater than the interorbital width, which equals or nearly equals the width of the upper eyelid; tympanum moderately or feebly distinct, its diameter two-fifths to three-fifths that of the eye, not greater than the length of the inner metatarsal tubercle; its distance from the eye equals two-thirds to once its diameter.

Fingers very obtuse, or slightly swollen at the end, first not extending or extending but slightly beyond second; subarticular tubercles strongly developed.

Hind limb very long, the tibio-tarsal articulation reaching the tip of the snout or beyond; heels overlapping when the limbs are folded. Tibia as long as or a little shorter than the fore limb, and at least slightly longer than the foot. Toes almost entirely

webbed, even in the very young, with obtuse, slightly swollen tips, and large and very prominent subarticular tubercles. Inner metatarsal tubercle soft, oval, measuring two-fifths to one-half the length of the inner toe; a very distinct tubercle at the base of the fourth toe.

Skin of upper parts smooth, or rough with small warts. Dorso-lateral fold narrow and not very prominent, sometimes interrupted, running straight or but very slightly curved from the temple to the groin; the distance between the dorso-lateral folds on the scapular region equals one-fifth to one-fourth the length from snout to vent.

Grey, grey-brown, reddish, olive, yellow, or yellowish-olive above, with small or indistinct darker spots, or speckled with blackish, rarely with irregular black spots on the back; small reddish or orange blotches may be scattered on the back and sides and on the upper eyelids; glandular lateral folds lighter, sometimes reddish; a dark band may be present across the interorbital region; Λ-shaped interscapular marking sometimes present, sometimes ill-defined or absent. Canthus rostralis and temporal fold brown or blackish; loreal region down to the border of the lip dark; a dark olive or brown temporal spot; a light streak from below the eye to the angle of the mouth. No large spots on the flanks; limbs with dark brown or olive cross-bands, sometimes replaced by dots; hinder side of thighs yellowish, dotted with brown, brownish, or dark brown with whitish dots. Lower parts cream-colour; throat with grey, brown, or blackish marblings, with a median light area; dark marblings, dots, or spots may be present on the breast; lower surface of hind limbs yellowish or flesh-colour, with or without brown dots or vermiculations. Iris pale golden, more or less obscured with brown.

One of the male specimens from Monte Morello, sent me by Count Peracca, belongs to that aberration

SKELETON.—Fronto-parietals broad and flat; ethmoid rounded anteriorly; nasals small, oblique, their posterior border rather convex than concave. Tibia longer than femur, but less markedly so than in *R. latastii* and *R. agilis*. Distal phalanges with very strongly developed transverse terminal expansion, T-shaped at the end, this being more conspicuous than in any other European species.

MEASUREMENTS OF SKELETON (in millimetres).

	♂		♀
Length of skull	12·5	...	15
Width of skull	14	...	16
Least interorbital width	3	...	3·5
Dorsal vertebral column	14	...	16
Urostyle	13	...	16
Humerus	13·5	...	14
Radius-ulna	8	...	9
Manus	12	...	13
Pelvis	16	...	20
Femur	20	...	25
Tibia	23	...	28
Tarsus	10	...	12
Pes	23	...	24

HABITS.—In its movements this species is somewhat intermediate between *R. temporaria* and *R. latastii*, being not quite so excitable and agile as the latter, which is fully comparable to *R. agilis*. The voice of the male during the breeding season may be expressed by *geck*, *geck*, *geck*, *geck*, *geck*, uttered in very rapid succession. The breeding season, in the Apennines, falls in the month of March, together with that of *R. agilis*, which occurs in the same localities. As we have mentioned in the Introduction, the great difference in the spermatozoa of the two species precludes the possibility of their intercrossing any more than in the case of *R. arvalis* and *R. temporaria*, which differ to an equal degree.

TADPOLE (Pl. III, fig. 4).—The tadpole of *R. græca*, although more nearly resembling that of *R. temporaria* than any other European species, differs from all its congeners in having the mouth quite as wide as the

interocular space, which equals once and a half the distance between the nostrils. The labial dentition is more developed even than in *R. temporaria*, the teeth forming $\frac{5}{4}$ or $\frac{4}{4}$ series, of which the second upper is but narrowly interrupted in the middle; the four lower series are either all continuous and occupying nearly the whole width of the lip, or the fourth is broken up in the middle. A single series of papillæ on the lower labial edge. Tail obtuse, once and two-thirds the length of the body, its depth about one-third its length.

Grey above, closely speckled with black, whitish beneath; muscular portion of the tail reticulated with black; caudal crests with small black spots or arborescent markings.

Total length, 48 mm.; body, 18; width of body, 12; tail, 30; depth of tail, 10.

Habitat.—This species was originally described from the mountains of Greece. The first specimens were obtained by von Oertzen at Musinitza, in the Korax mountains, on the limit between Doris and Ætolia, at an altitude of 5800 feet. I received several larval specimens from Dr. Krüper, which came from the Parnassos, at an altitude of about 3000 feet. More recently my friend Mr. Norman Douglass brought me from a journey to Greece several specimens, which he collected on the hills above Klimenti, in Northern Morea.

There is no doubt that the specimens from the mountains of Bosnia, referred by Boettger to *R. latastii*, belong to this species, as pointed out by Werner; I have examined a male specimen from Travnik submitted to me by Dr. F. Werner; and another from Tajce, collected by Prof. E. Brandis, is now in the British Museum. Werner obtained it also from Montenegro, and Peracca has ascertained its presence in the Apennines (Monte Morello, near Florence, 2600 feet; Siena, 2600 feet; and Perugia), where it occurs in company with *R. agilis*. The

specimens from Tuscany and Umbria mentioned by Bedriaga in his description of *R. latastii* must also be identified with *R. græca*. I have strong reason to believe the species will be found all along the Apennine chain, as Prof. Giglioli kindly informs me a brown frog closely resembling *R. latastii* occurs in the provinces Umbria, Rome, Terra di Lavoro, Basilicata, and Calabria, at altitudes varying between 1300 and 3000 feet. It is to be hoped Prof. Giglioli will soon be able to undertake a careful study of the vast material at his command, and thus settle in a more exact manner the range of the various species of brown frogs in the Italian peninsula.

Since the preceding lines were set up in type I have received from Count Peracca, who is now (March, 1898) on a collecting expedition in the south of Italy, information as to the occurrence of this species in the environs of Potenza, Basilicata. We therefore feel justified in concluding that all previous references to *R. temporaria* and *R. latastii* from the Italian peninsula, south of Florence, are based on specimens of *R. græca* and *R. agilis*.

The three specimens figured on Pl. XXII are from Italy. I am indebted for them to Count Peracca. The left-hand figure is taken from a male from Siena; the right-hand figures represent a female from Monte Morello (Florence), and the aberrant male, from the same locality, noticed above, p. 316.

Rana iberica

Rana latastii.

18. RANA IBERICA.

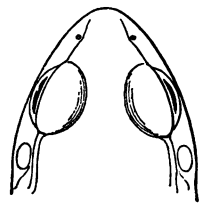
(Plate XXIII.)

Rana iberica, Boulenger, Bull. Soc. Zool. France, 1879, p. 177; Boscá, Bull. Soc. Zool. France, 1880, p. 259; Boulenger, Cat. Batr. Ecaud., p. 46 (1882); Boettger, Sitzb. Ak. Berl., 1887, p. 180; Héron-Royer & Van Bambeke, Arch. de Biol., ix, 1889, p. 258, pl. xvi, fig. 4; Bedriaga, Bull. Soc. Nat. Moscou, 1889, p. 345, Amph. Rept. Portug., p. 9 (1889), and Larves Batr. Portug., p. 8 (1891); Boulenger, Ann. & Mag. N. H. (6), viii, 1891, p. 350, and Proc. Zool. Soc., 1891, p. 608, pl. xlv, fig. 5.

Vomerine teeth in two small oblique series behind the level of the choanæ.

Head as long as broad or a little broader than long, moderately depressed. Snout short, obtuse, rounded; canthus rostralis distinct; loreal region not very oblique, slightly concave; nostril equidistant from the eye and the end of the snout, or slightly nearer the latter; the distance between the nostrils a little greater than the interorbital width, which equals the width of the upper eyelid; tympanum distinct, its diameter one-half to three-fifths that of the eye; the distance between the eye and the tympanum equals two-thirds to three-fourths the diameter of the latter.

FIG. 116.



Upper view of head.

Fingers obtuse, first not extending, or extending but very slightly, beyond second; subarticular tubercles moderately developed.

Hind limb very long, the tibio-tarsal articulation reaching beyond the tip of the snout in the adult, the tip of the snout in the young; heels strongly overlapping when the limbs are folded. Tibia but slightly shorter than the fore limb, and nearly as long as the foot. Toes three-fourths or even almost entirely webbed, the web with more or less deep crescentic notch; subarticular tubercles moderately large and

prominent. Inner metatarsal tubercle small, soft, oval, measuring about one-third the length of the inner toe; a small and more or less indistinct tubercle usually present at the base of the fourth toe.

The skin may be perfectly smooth, or the back rough with granules and small round warts; hinder side of thighs granular. Dorso-lateral fold narrow but rather prominent, running straight from the temple to the groin; the distance between these folds on the scapular region equals two-ninths to one-fourth the length from snout to vent.

Coloration very variable. Upper parts yellowish-brown, greyish-brown, or reddish, with or without dark brown spots; not unfrequently the back is largely blotched with yellowish, and the sides may be spotted with pure white; or the back may be closely speckled and spotted with black; flanks often with dark brown spots or marblings; a dark brown Λ-shaped marking sometimes present on the scapular region; dorso-lateral folds usually with a dark brown outer margin; a dark brown canthal streak and a large dark brown or black temporal spot; a whitish streak from below the eye to the angle of the mouth; limbs with dark cross bands, which may be very indistinct; hinder side of thighs usually speckled or marbled with dark brown. Lower parts whitish, rosy under the limbs, and more or less profusely spotted or marbled with brown, especially on the throat and breast; the middle line of the throat, however, usually unspotted. In a small living male the throat was flesh-colour powdered with gold-dust; the lower surface of the limbs was also carneous, but unpigmented. Iris golden, entirely, or brown in its lower moiety.

Males are devoid of vocal sacs, and the nuptial excrescences of the inner finger are granular and grey-brown, as in *R. agilis*, and thus different from those of *R. temporaria, græca*, and *latastii*.

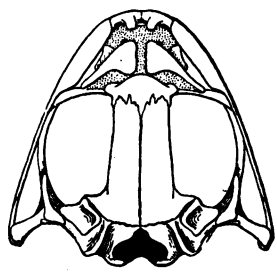
MEASUREMENTS (in millimetres).

	♂		♀	
	1.	2.	3.	4.
From snout to vent	42	40	54	50
Head	14	14	17	16
Width of head	15	15	20	17
Diameter of eye	4	4	5	5·5
Interorbital width	3	3·5	4	4
From eye to nostril	3	3	4	3·5
,, end of snout	6	6	8	7
Diameter of tympanum	2·5	2·5	3	3
From eye to tympanum	2	2	2	2
Fore limb	26	28	35	31
Hind limb	78	74	98	86
Tibia	24	24	31	28
Foot	26	24	30	27
Inner toe	6	5·5	7	6·5
Inner metatarsal tubercle	2	2	2·5	2

1, 3. Serra de Gerez: Gadow. | 2, 4. Coimbra: Gadow.

SKELETON.—Except for the longer tibia, resembles that of *R. temporaria*. The nasals are likewise pyri-

FIG. 117.



Upper view of skull.

form, with concave posterior border, the fronto-parietals broad and flat, and the upper surface of the ethmoid obtuse or rounded in front.

The shape of the nasals, and the lesser terminal expansion of the distal phalanges, serve to distinguish the skeleton of this species from that of its nearest ally, *R. græca*.

MEASUREMENTS OF SKELETON (in millimetres).

	♀
Length of skull	15
Width of skull	16
Least interorbital width	4
Dorsal vertebral column	16
Urostyle	15
Humerus	14
Radius-ulna	9
Manus	13
Pelvis	19
Femur	25
Tibia	28
Tarsus	12
Pes	27

HABITS.—We know very little yet about the habits of this species. Boscá says it is found in mountain streams and springs and among the grass on their borders, never far from water. Males were observed by him in breeding attire at the end of March, at which time larvæ were also to be found. The few specimens I have been able to observe alive made tremendous leaps, and their voice in summer resembled that of *R. agilis*. A small male in breeding costume, received 24th March, 1897, from Mr. Moller of Coimbra, had a rather deeper note, *cock, cock, cock*.

TADPOLE (Pl. III, fig. 5).—This frog is intermediate between *R. temporaria* and *R. agilis* in its larval as well as in its perfect state. Width of mouth much less than the interocular space, which equals nearly twice the distance between the nostrils. Series of labial teeth $\frac{3}{4}$, rarely $\frac{4}{4}$, the second upper series widely interrupted in the middle, the third very short; first lower series short, hardly half the length of the second, fourth interrupted in the middle. The beak resembles that of *R. agilis*, and in one of the four specimens before me the upper mandible is likewise provided with a large black tubercle in the middle of its basal portion.

Tail obtuse, once and a half to once and three-fourths the length of the body, its depth about one-third its length.

Lines of muciferous crypts very distinct, as in *R. agilis*.

The colour of the upper parts varies from reddish-brown to blackish-brown; belly greyish or whitish; caudal crests brownish, the upper darker than the lower, with brown dots and large blackish spots, which are also present on the muscular part.

Total length, 49 mm.; body, 17; width of body, 12; tail, 32; depth of tail, 11.

HABITAT.—*Rana iberica*, hitherto observed only in Portugal and North-western Spain, is principally bound to the mountains, where it is found up to 4500 feet or even higher. It has been obtained in Galicia and New Castille; in the Serra de Gerez, the Valle Passos, near Coimbra and Beira, the Serra de Soajo, near Lisbon, and in the Serra de San Mamede; it is thus on record from all the provinces of Portugal with the exception of Algarve.

This species has also been recorded, with some doubts as to the correctness of the identification of a single specimen, from the Lac d'Aubert, Hautes Pyrénées, by Belloc (C. R. Assoc. Franç., Pau, 1892, ii, p. 520). This specimen was probably nothing but an aberrant and badly preserved half-grown *Rana temporaria*.

I am indebted to the kindness of Mr. F. A. Moller, of the Botanic Gardens, Coimbra, for the specimens figured on Pl. XXIII. The specimen to the right is a male, that to the left a female.

19. Rana latastii.

(Plate XXIII.)

Rana latastei, Boulenger, Bull. Soc. Zool. France, 1879, p. 180, and Cat. Batr. Ecaud., p. 46 (1882); Camerano, Mem. Acc. Torin. (2), xxxv, 1883, p. 269, pl. i, figs. 2—4; Peracca, Boll. Mus. Torin., i, 1886, No. 5; Borelli, Boll. Mus. Torin., i, 1886, No. 14; Boulenger, Ann. and Mag. N. H. (6), viii, 1891, p. 351, and Proc. Zool. Soc., 1891, p. 608, pl. xlv, fig. 6.

Rana temporaria, part., De Betta, Atti Ist. Venet. (2), iv, 1885, p. 45.

Rana latastii, part., Bedriaga, Bull. Soc. Nat. Moscou, 1889, p. 338.

Vomerine teeth in two small, oval, oblique groups behind the level of the choanæ.

Head nearly as long as broad, sometimes slightly broader than long, sometimes slightly longer than broad, more depressed than in *R. temporaria* and *R. iberica*, less so than in *R. agilis*. The snout varies much in shape: it may be short and rounded,

Fig. 118.

Upper views of heads.

as in a platyrrhine *R. temporaria*, or as long, as pointed, and as prominent as in a typical *R. arvalis* (two extreme forms are represented in Fig. 118); loreal region more oblique than in *R. temporaria* and *R. iberica*, less so than in *R. agilis;* nostril equidistant from the eye and the end of the snout, or slightly nearer the latter; the distance between the nostrils equals the interorbital width, which equals the width of the upper eyelid; tympanum very distinct, its diameter one-half to two-thirds the diameter of the

eye; the distance between the eye and the tympanum equals one-half to two-thirds the diameter of the tympanum.

Fingers obtuse, first extending beyond second; subarticular tubercles moderately developed.

Hind limb very long, the tibio-tarsal articulation reaching beyond the tip of the snout; heels strongly overlapping when the limbs are folded; tibia as long as the fore limb or a little shorter, as long as the foot or a little longer. Toes three-fourths webbed in the female, the web with crescentic emargination, three-fourths or almost entirely webbed, and with straight or even convex border to the web in the breeding male; subarticular tubercles moderately large and prominent; inner metatarsal tubercle small, soft, oval, measuring about one-third the length of the inner toe; a small outer metatarsal tubercle is usually present at the base of the fourth toe.

Skin smooth, or with a few small warts scattered on the back; back of the thighs granular. Dorso-lateral glandular fold narrow and more or less prominent, running nearly straight from the temple to the groin; the distance between these folds on the scapular region equals one-fourth to one-fifth the length from snout to vent.

The coloration varies less than in *R. temporaria* and *R. iberica*, but more than in *R. agilis*. Upper parts greyish or reddish brown, usually with a few dark brown spots; a dark cross-bar between the eyes, and a Λ-shaped marking on the scapular region; small orange or red spots may be present on the back, and, very rarely, a few ink-black blotches; the glandular lateral folds usually not paler than the surroundings, sometimes reddish, often with a dark brown outer margin; no large spots on the flanks; a canthal streak and sometimes the whole of the loreal region dark brown; a dark brown or blackish temporal spot; a light streak from below the eye to the angle of the mouth; hind limbs with well-marked olive or dark brown cross-bars;

hinder side of thighs speckled or spotted with brown. Lower parts white or pinkish, the throat and the hind limbs often of a bright pink or salmon-colour; throat and breast spotted or mottled with grey or brown, with the median line of the throat and usually a cross-line on the breast unspotted, the two forming a ⊥-shaped white or pink marking; belly and lower surface of thighs sometimes spotted, sometimes immaculate. Iris golden, much obscured with brown, at least in its lower half.

Males distinguished by much stronger fore limbs, and a large pad on the inner side of the inner digit, which, during the breeding time, is covered with dark brown horny excrescences or minute spinules, forming three or four distinct patches. No vocal sacs.

MEASUREMENTS (in millimetres).

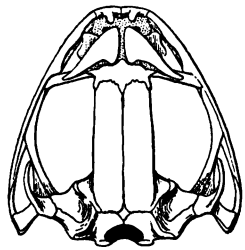
	♂			♀		
	1.	2.	3.	4.	5.	6.
From snout to vent	48	55	54	62	58	56
Head	16	17	16	18	17	18
Width of head	15	18	18	19	18	18
Diameter of eye	5	5·5	6	6	5·5	6
Interorbital width	4	4·5	4	4	4	4
From eye to nostril	3·5	4	4	4·5	4	4
„ end of snout	7	8	7·5	9	8	8
Diameter of tympanum	3	4	3·5	3·5	4	4
From eye to tympanum	2	2	2	2·5	2	2
Fore limb	30	35	37	38	34	35
Hind limb	84	95	103	113	106	104
Tibia	28	33	35	37	35	34
Foot	26	31	33	35	24	32
Inner toe	6	6·5	7	8	7	6·5
Inner metatarsal tubercle	2	2·5	2·5	2·5	2 5	2

1. Castelfranco: De Betta.
2. Varese: Camerano.
3. Florence: Giglioli.
4. Turin: Peracca.
5. Novara: Camerano.
6. Venice: De Betta.

SKELETON.—Fronto-parietals broad and flat, their width in the middle contained twice to twice and a half in their length; ethmoid rounded or obtusely pointed anteriorly. Nasals small, oblique, separated from each other on the median line, their posterior border nearly straight, or if concave less markedly so

than in *R. temporaria*. Zygomatic process of the squamosal a little longer than the posterior. Ver-

FIG. 119.



Upper view of skull.

tebral column twice to twice and a half the length of the skull. Transverse processes unequal in length. Tibia considerably longer than the femur, which measures nearly twice the length of the tarsus. Two bones in the præpollex and two in the præhallux.

MEASUREMENTS OF SKELETON (in millimetres).

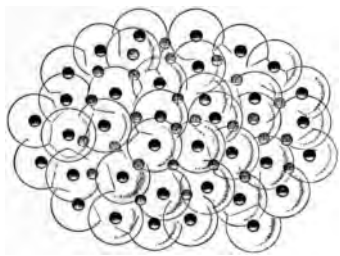
	♂		♀
Length of skull	15	...	17
Width of skull	14	...	17
Least interorbital width	3	...	4
Dorsal vertebral column	17	...	19
Urostyle	15	...	16
Humerus	14	...	15
Radius-ulna	9	...	10
Manus	12	...	14
Pelvis	18	..	22
Femur	24	...	28
Tibia	28	...	33
Tarsus	12	...	14
Pes	26	...	29

HABITS.—Much the same as in *R. agilis*, which *R. latastii* also resembles in the enormous leaps it is able to make. Its voice is feeble, and may be rendered by *keck-keck-keck-keck-keck*, uttered in rapid succession. Peracca has observed it spawning near Turin in March, a little later than *R. agilis*.

Although so closely allied and living side by side in many localities, these two species never appear to interbreed. As in *R. temporaria* and *R. arvalis*, this is probably to be ascribed mainly to the great difference in the seminal elements, as mentioned on p. 77 of the Introduction.

Eggs.—According to Count Peracca, to whom I am also indebted for eggs of this frog, the vitelline sphere is blackish-brown, with the lower third white, and measures $1\frac{3}{4}$ mm.; the mucilaginous envelop is also smaller than in *R. agilis* and *R. temporaria*, 6 or

Fig. 120.



7 mm. in diameter. The embryo, on leaving the egg on the thirteenth or fourteenth day, is only half as long as that of *R. agilis*.

Tadpole (Pl. III, fig. 6).—Intermediate between *R. temporaria* and *R. agilis*. Width of mouth equalling the distance between the nostrils and two-thirds the distance between the eyes. Series of labial teeth $\frac{3}{4}$, the second upper series very widely interrupted in the middle, the third extremely short; first lower series very short, hardly half the length of the second; fourth interrupted in the middle. Beak as in *R. temporaria*. Tail acutely pointed, twice as long as the body, its depth one-third its length. Lines of muciferous crypts very distinct, as in *R. agilis*.

Brown above, whitish beneath; caudal crests whitish, dotted with dark brown, the upper with some larger spots.

Total length, 44 mm.; body, 14; width of body, 10; tail, 30; depth of tail, 10.

HABITAT.—*Rana latastii* was originally discovered near Milan, where it appears to be very common, and occurs in company with *R. agilis*. Its presence has since been ascertained in various localities in Piedmont, Lombardy, and Venitia, from the province of Turin to the province of Udine, and in the province of Florence, but we are at present uncertain as to the southern limit of its range in the Italian peninsula, owing to the confusion that has taken place with *R. græca*. It has not yet been recorded from Switzerland, where it will no doubt be found in Tessin, being abundant at Varese, not far from the Swiss frontier.

In North Italy *R. latastii* is a form of the plain, being replaced in the mountains by *R. temporaria;* in the peninsula it is probably found at no very considerable altitude, its place being taken from 2500 feet and above by its close ally *R. græca*, and also by *R. agilis*, which in the Italian peninsula is at home in the mountains as well as at sea level.

Male and female from Turin, received from Count Peracca, are figured on Pl. XXIII.

20. RANA AGILIS.

(Plate XXIV.)

Rana temporaria, part., Daudin, Hist. Rain. Gren. Crap., p. 46, pl. xv, fig. 2 (1803), and Hist. Rept., viii, p. 94 (1803); Duméril & Bibron, Erp. Gén., viii, p. 358 (1841); Günther, Cat. Batr. Sal., p. 16 (1858); Schreiber, Herp. Eur., p. 125 (1875); De Betta, Atti Ist. Venet. (6), iv, 1885, p. 45.

Rana temporaria (non Linnæus), Millet, Faune Maine et Loire, ii, p. 664 (1828).

Rana dalmatina, Fitzinger, in Bonaparte, Mem. Acc. Torin. (2), ii, 1839, p. 249.*

Rana agilis, Thomas, Ann. Sc. Nat. (4), iv, 1855, p. 365, pl. vii, figs. 1—4; Fatio, Rev. & Mag. Zool. (2), xiv, 1862, p. 81, pls. vi & vii; Steenstrup, Vid. Meddel., 1869, p. 16; Fatio, Vert. Suisse, iii, p. 333 (1872); De l'Isle, Ann. Sc. Nat. (5), xvii, 1873, art. 3, p. 3; De Betta, Faun. Ital., Rett. Anf., p. 65 (1874); Lataste, Herp. Gir., p. 233 (1876); Leydig, An. Batr., p. 143 (1877); Lessona, Atti Acc. Lincei, Mem. Cl. Sc. fis., i, 1877, p. 1074, pl. iii; Héron-Royer, Bull. Soc. Zool. France, 1878, p. 128, pl. iii, fig. 1; Boulenger, Bull. Soc. Zool. France, 1879, p. 183, 1880, p. 209, and Cat. Batr. Ecaud., p. 46 (1882); Camerano, Mem. Acc. Torin. (2), xxxv, 1883, p. 274, pl. i, figs. 5—8; Héron-Royer, Bull. Soc. Et. Sc. Angers (2), xiv, 1885, p. 124, and Bull. Soc. Zool. France, 1886, p. 681; Borelli, Boll. Mus. Torin., i, 1886, No. 14; Boettger, in Radde, Faun. Flor. Casp.-Geb., p. 77 (1886), and Sitzb. Ak. Berl., 1888, p. 148; Leydig, Verh. Phys. Ges. Würzb. (2), xxii, No. 6, 1888, and Zool. Anz., 1889, p. 316; Héron-Royer & Van Bambeke, Arch. Biol., ix, 1889, p. 255; Bedriaga, Bull. Soc. Nat. Moscou, 1889, p. 323; Wolterstorff, Zool. Anz., 1890, p. 260; Méhely, Zool. Anz., 1890, p. 447; Melsheimer, Verh. Ver. Rheinl. (5), vii, 1890, p. 82; Boulenger, Proc. Zool. Soc., 1891, p. 609, pl. xlv, fig. 7; Méhely, Beitr. Mon. Kronstadt, Herp., p. 61 (1892), and Math. Term. Közl. Budapest, xxv, 1892, p. 43, pls. iii & v; Leydig, Zool. Gart., xxxiii, 1892, p. 321; Boettger, Ber. Senck. Ges., 1892, p. lxxxii; Stoll, Vierteljahrschr. Nat. Ges. Zürich, xxxvii,

* The strict application of the law of priority would require the adoption of this name in preference to that proposed by Thomas sixteen years later, as the former was accompanied by a definition ("Gigantea, pedibus posticis longissimus"), however inadequate, and specimens so labelled by Fitzinger are preserved in the Vienna Museum. However, this is one of those cases in which, it appears to me, conservatism is desirable, as the name *agilis* was the first to appear in connection with a proper description, and has been so generally in use within the last half-century. Similar considerations have guided me in the naming of the two species of the genus *Bombinator*, and I hope, in the interest of the stability of nomenclature, they will commend themselves to future workers.

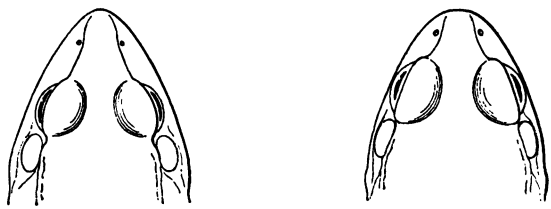
1892, p. 337; Boulenger, The Zool., 1893, p. 355; Melsheimer, Verh. Nat. Ver. Rheinl., l, 1893, Korr., p. 44; Douglass, Herp. Baden, p. 45 (1894); Knauthe, Zool. Gert., xxxv, 1894, p. 286; Werner, Rept. Amph. Oesterr.-Ung., p. 94 (1897); Dürigen, Deutschl. Amph., p. 459, pl. iii, fig. 2 (1897); Gadeau de Kerville, Faun. Norm., iv, p. 199 (1897).

Rana gracilis, Fatio, Rev. & Mag. Zool. (2), xiv, 1862, p. 81, pls. vi & vii.

Vomerine teeth in two oblique series or oval groups behind the level of the choanæ.

Head as long as broad or a little broader than long, much depressed. Snout rounded or obtusely acuminate, more or less projecting, usually as long as or a little longer than the diameter of the orbit,—exceptionally a little shorter, as shown on right hand of Fig. 121; canthus rostralis distinct; loreal region

FIG. 121.



Upper views of heads.

oblique, concave; nostril equidistant from the eye and the end of the snout, or slightly nearer the former; the distance between the nostrils exceeds the interorbital width, which equals two-thirds to three-fourths the width of the upper eyelid; tympanum very distinct, its diameter two-thirds to five-sixths that of the eye; the distance between the eyes and the tympanum equals one-fifth to two-fifths its diameter.

Fingers obtuse, first extending beyond second; subarticular tubercles large and very prominent.

Hind limb very long, the tibio-tarsal articulation reaching the tip of the snout or beyond in the adult, not quite so far in the young, the heels strongly overlapping when the limbs are folded; tibia as long as the fore limb or a little shorter, as long as the foot or

a little longer. Toes one-half to three-fourths webbed, the last or two last phalanges of the fourth toe free, the web with crescentic emargination, or with almost straight border in some breeding males; subarticular tubercles large and prominent; inner metatarsal tubercle oval, very prominent, measuring one-third to one-half the length of the inner toe; a small tubercle usually present at the base of the fourth toe.

Fig. 122.

Hand and foot of male (lower aspect).

Skin smooth, or with a few flat glands; a strong but narrow glandular dorso-lateral fold, often broken up along its course, running straight from the temple to the groin, or slightly converging towards its fellow between the shoulders; the distance between the folds on the scapular region two-elevenths to two-ninths the length from snout to vent; glandular folds bordering the temporal spot above and below.

Skin smooth beneath, except on the posterior half of the thighs, which are finely granular.

Upper parts varying from yellowish or pinkish to grey or dark brown, uniform or finely speckled with blackish; a few small dark spots may be present on the back, and a Λ-shaped dark marking between the shoulders is usually distinct; rarely a few small ink-black spots scattered on the back; flanks unspotted, or with small spots; glandular lateral folds not much lighter than the surroundings; loreal and temporal regions dark brown or blackish, separated from the border of the lip by a more or less distinct light streak; a dark brown or black streak on the inner side of the arm; limbs with regular brown or blackish cross-bands;

hinder side of thighs brownish, or yellow speckled with brown. Lower parts white or yellowish-white, immaculate, or with small brown, blackish, or red dots or arborescent lines on the throat and sides; lower lip usually marbled with grey or brown; inguinal and femoral regions often bright yellow, the feet pinkish.

Iris golden in its upper half, brown or nearly black in its lower half.

Males distinguished by stronger fore limbs, although not to the same extent as in *R. arvalis* and *R. temporaria*, a shorter body, and somewhat more developed webs between the toes. A moderately developed pad is present on the inner side of the first finger, and this is covered during the breeding season with greyish granular excrescences, forming a single patch extending to the tip of the finger. Vocal sacs are absent.

MEASUREMENTS (in millimetres).

	♂				♀			
	1.	2.	3.	4.	5.	6.	7.	8.
From snout to vent	61	56	57	49	76	76	65	68
Head	19	17	20	16	24	23	18	21
Width of head	20	19	20	17	24	24	20	21
Diameter of eye	6	6	6	5	7	6·5	6	6
Interorbital width	4	3·5	3·5	3	5	4	4	3·5
From eye to nostril	3·5	3	3·5	3·5	4·5	4	4	4
From eye to end of snout	8·5	8	8	8	10	10	8·5	9
Tympanum	5	4	5	3·5	5·5	5	5	5
From eye to tympanum	1·5	1·5	1·5	1	2	2	1·5	1·5
Fore limb	37	35	37	30	43	44	41	39
Hind limb	109	101	109	86	134	128	121	118
Tibia	36	33	35	29	44	44	40	40
Foot	34	32	34	27	41	40	37	36
Inner toe	7	6	6	5·5	8	9	9	7·5
Inner metatarsal tubercle	2·5	3	3	2	3	4	3	3·5

1, 5. St. Malo: Boulenger.
2. Jersey: Hornell.
3, 6. Vienna: Werner.
4, 8. Marcellise, Verona: De Betta.
7. Bologna: Bianconi.

According to Werner, this species reaches, in Dalmatia, a length of 90 mm. from snout to vent. It is on such large specimens that Fitzinger founded his *Rana dalmatina*.

Skeleton.—Skull twice to twice and one-fourth in the length of the vertebral column. Fronto-parietals slightly grooved along the middle, twice and a half to three times as long as broad anteriorly; nasals widely separated from each other, oblique, with straight or slightly concave posterior border; upper surface of ethmoid more or less acutely pointed anteriorly; zygomatic process of squamosal as long as or a little shorter than the posterior.

Diapophyses of third vertebra once and a half as long as those of the eighth, and a little longer than the sacral.

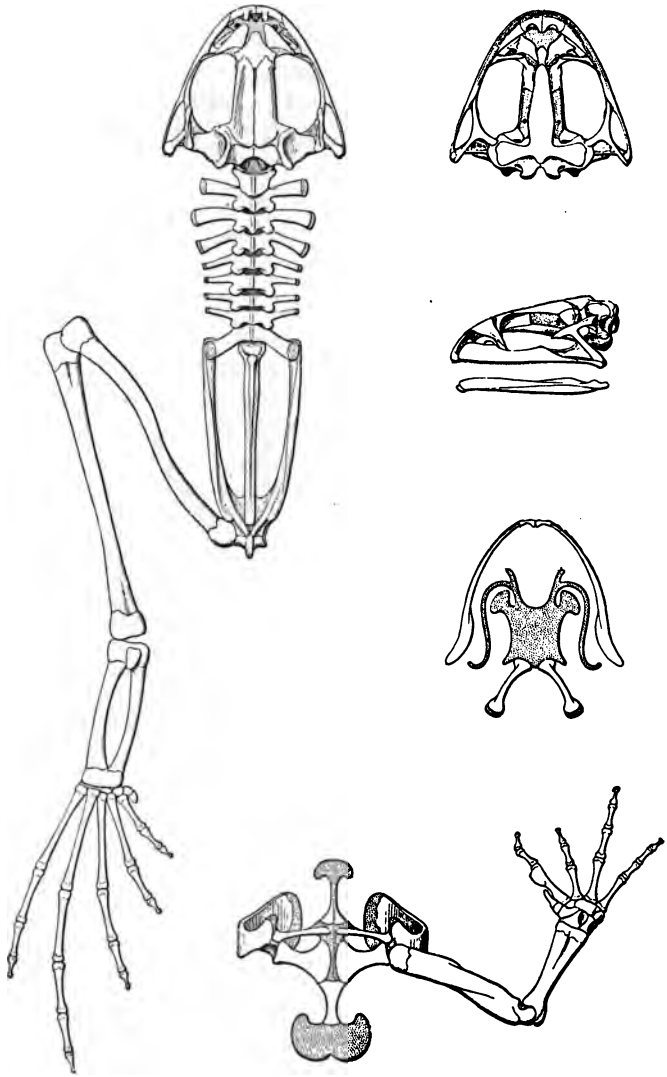
Tibia considerably longer than the femur, twice as long as the tarsus. Terminal phalanges slightly expanded at the end. Two bones to the præpollex, and two to the præhallux.

Measurements of Skeleton (in millimetres).

	♂		♀
Length of skull	19	...	18
Width of skull	19	...	19
Least interorbital width	4	...	3·5
Dorsal vertebral column	21	...	21
Urostyle	20	...	20
Humerus	17	...	16
Radius-ulna	12	...	11
Manus	16	...	15
Pelvis	24	...	25
Femur	30	...	30
Tibia	35	...	34
Tarsus	17	...	17
Pes	34	...	33

Habits.—The agile frog well deserves its name; its extremely long hind limbs enable it to cover a surface of six feet at one leap. The delicate texture of its skin and the general slenderness of its build impart to this frog an elegant appearance far surpassing that of any of its European congeners. The shade of the

Fig. 123.



Skeleton of male.

upper parts, constantly varying under atmospheric influences, often suggests the colour of dry leaves, among which the frog is, in fact, not unfrequently met with in woods, and under which it seeks shelter when pursued. Woods, together with swampy meadows and banks overgrown with long grass, constitute its usual abode. It is never found in fields or gardens, or among roadside brambles and nettles like the common frog, which, however, often associates with it in the wilderness. The voice is feeble and clear, and may be rendered by *co*, *co*, *co*, or *cor*, *cor*, *cor*, uttered rapidly.

Rana agilis is found in the water only during the breeding season, which falls in France usually three or four weeks later than in *R. temporaria*, between the middle of February and the beginning of April, isolated individuals spawning exceptionally as tardily as May : in Lower Austria, according to Werner, the breeding season of the two species coincides, and takes place in the latter half of March. The eggs are usually deposited on the borders of small ponds or pools in flooded quarries. Specimens from Turin sent to me the winter before last by my friend Count Peracca, spawned in an aquarium out of doors on the 20th and 21st of February; owing to the cold weather and frosty nights that followed, the development of the eggs was at first almost completely arrested, and the first embryos did not emerge from the mucilage until the 15th of the following month.

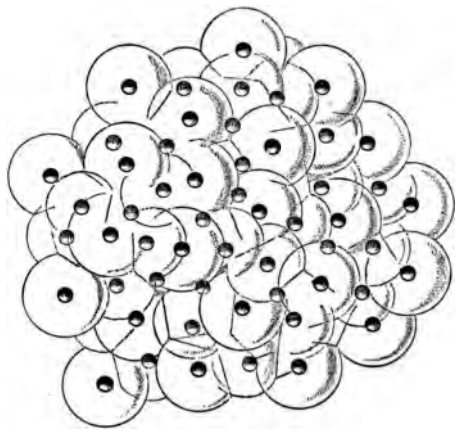
The young leave the water by the end of June or beginning of July, rarely as late as the middle of August.

The pairing takes place as in *R. temporaria*, but is of much shorter duration, the females usually resorting to the water only at night, and when quite ready to spawn. Specimens in embrace are therefore seldom observed in the daytime. The males do not, generally speaking, show the same genesic frenzy as the common frog, seldom seizing females of other species in the absence of legitimate mates; they often hibernate in

the mud under water, in company with the common frog, where the two species co-exist.

EGGS.—Vitelline sphere measuring 2 to 2½ mm. (up to 3 according to Peracca), blackish-brown in the upper

FIG. 124.



half, whitish in the lower; mucilaginous envelop, when swollen out, measuring 9 to 12 mm. The eggs form a single lump, smaller as a rule than in *R. temporaria*, and do not float. According to Héron-Royer their number varies between 669 and 1200. I have myself counted 1188 and 1415 in broods from Turin. The embryo, on leaving the egg, is of a paler brown than in *R. temporaria*, and its external gills are much less developed and unpigmented.

TADPOLE (Pl. III, fig. 7).—In general form similar to *R. esculenta*, but snout rather shorter, the nostrils being equidistant from the eyes and the end of the snout, and spiraculum considerably nearer the posterior than the anterior extremity of the body. Interocular space twice as great as the distance between the nostrils. Tail twice to twice and a half as long as the body, pointed and attenuate or submucronate at the end, its depth about twice and two thirds in its length; upper

crest very convex, deeper than the lower, and extending upon the back as far as the level of the spiraculum.

Beak broadly edged with black, usually with a black tubercle or knob in the middle of the basal part of the upper mandible, which may be accompanied by a smaller one on each side. Usually two series of papillæ bordering the lower lip. Labial teeth in $\frac{3}{4}$ series, the second and third upper short and widely separated in the middle, the first lower short, the three others nearly twice as long and uninterrupted, or the fourth very narrowly interrupted in the middle.

Very distinct lines of crypts on the head and body. One of these forms a hoop, the ends of which approach on the upper lip, passing above the nostril and bordering the eye above and below; another begins behind the eye and bifurcates, the upper branch extending to the upper caudal crest, the lower to the middle of the muscular portion of the tail; a small branch may descend on each side at a short distance behind the eye, forming a sigmoid curve; another curved line on each side, bordering the spiraculum above (see Fig. 46, p. 104).

Pale brown or rufous above, with dark brown spots; sides with roundish golden spots between a brown or reddish network; belly white, with pale golden or mother-of-pearl spots; throat pink; muscular portion of tail pale brown or yellowish, with small brown or grey spots; caudal crests greyish-white, with white and small greyish-brown spots, which are scarcer on the lower crest; usually a few deep black spots on the upper edge of the upper crest.

Total length, 59 mm.; body, 18; width of body, 12; tail, 41; depth of tail, 15.

Habitat.—*Rana agilis* inhabits the greater part of France, from the north coast of Brittany, Normandy, and Paris to the foot of the Pyrenees and the Mediterranean littoral, but appears to be absent from the

north-east and the central plateau.* It also occurs in Jersey. It is rare and very local in Germany, the localities whence it has been reported being Strassburg, Linz on the Rhine, the Kaiserstuhl between Freiburg and the Rhine, Rothenburg on the Tauber, Würzburg and Traunstein in Bavaria, and about the Zobten, south of Breslau, in Silesia.† In Switzerland it is known from the cantons Geneva, Vaud, Bern, Zurich, Valais, and Tessin; in the Austro-Hungarian Empire from Bohemia, Lower Austria, Styria, the Tyrol, Illyria, Croatia, Dalmatia, Hungary, and Transylvania. It appears to be pretty generally distributed in Italy, and is on record from Modica, Sicily. It is further known from Bosnia, Albania, and Greece. The only localities in Asia whence *R. agilis* has been recorded are Lenkoran, on the south-western coast of the Caspian Sea (Boettger), Suchum Kale, Transcaspia, and Konkur Valley, S. of R. Ili (Bedriaga), the two latter requiring confirmation. Strauch has also referred some specimens obtained by Przewalski in the Chinese province Ordos to what he called the "*agilis*" form of *R. temporaria*, but these will no doubt prove to belong to *R. japonica*, a species which bears great resemblance to *R. agilis*.

Rana agilis is, on the whole, more a form of the plain, being replaced in the mountains by *R. temporaria*; it is, however, known to reach an altitude of 4200 feet in the Alps of Switzerland, and to extend pretty high up in the Tyrol and in Transylvania, as well as in the Apennines.

* Dealing with the mucilaginous capsules of frog ova, R. Florentin ('Bull. Sci. France Belg.,' xx, 1897, p. 142), mentions having made experiments at Nancy on *Rana agilis*, Thom. As this statement might result in French Lorraine being erroneously or prematurely added to the habitat of this species, I may point out that an error of identification has been made, since had the author really seen eggs of *R. agilis* he would not have attributed to frog spawn generally the floating power which is possessed by that of *R. temporaria* alone among European Batrachians.

† I have examined a specimen from this locality.

The specimens figured on Pl. XXIV are from Turin, again the gift of Count Peracca. The smallest specimen is a male; the two others are females, one being partially concealed among dead leaves.

APPENDIX.

LIST OF THE SPECIMENS PRESERVED IN THE BRITISH MUSEUM (NATURAL HISTORY).*

1. *Discoglossus pictus*, Otth.

1–4. ♂, ♀, & hgr.	Near Corunna	M. V. L. Seoane.
5–7. ♂ ♀	Sierra Morena	M. E. Boscá.
8–13. Hgr. & yg.	Ciudad Real	M. E. Boscá.
14–16. ♂ ♀	Coimbra	Dr. H. Gadow.
17–22. Larvæ	Coimbra	Dr. J. de Bedriaga.
23–24. ♂	Oporto	Dr. H. Gadow.
25–26. Hgr.	Sartene, Corsica	Prof. H. H. Giglioli.
27–28. Hgr. & yg.	Corsica	M. A. Dollfus.
29–30. Larvæ	Montecristo	Prof. H. H. Giglioli.
31–34. ♂ ♀	Giglio	Prof. H. H. Giglioli.
35. ♂	Luras, Sardinia	Prof. L. Camerano.
36. ♀	Cagliari, Sardinia	Prof. L. Camerano.
37. ♂	Sardinia	Leyden Museum.
38–39. ♂	Malta	Miss E. Attersoll.
40. Hgr.	Malta	Col. Feilden.
41–47. ♂ ♀	Malta	J. Norman Douglass, Esq.
48–49. ♂, skel.	Malta	J. Norman Douglass, Esq.
50. ♀	Tangier	M. H. Vaucher.
51–54. Hgr. & yg.	Between Mogador and Morocco	SenckenbergMuseum.
55–64. ♂ ♀	Oran	M. E. Chevreux.
65. ♀, skel.	Oran	M. E. Chevreux.
66–75. Larvæ	Oran; bred in London	G. A. Boulenger.
76. Eggs & embryos	Oran; bred in London	G. A. Boulenger.
77–78. ♂	Tlemsen, Prov. Oran	Dr. J. Anderson.
79. ♂	Algiers	P. L. Sclater, Esq.
80. ♀	Algiers	
81–82. ♂ ♀	Algiers	M. Héron-Royer.
83–84. Hgr. & yg.	Algiers	Dr. J. Anderson.

* No number of specimens higher than ten in each bottle is recorded in this list.

85–88. Larvæ	Algiers	Dr. J. de Bedriaga.
89–94. ♂, ♀, & yg.	Hammam R'irha, Prov. Algiers	Dr. J. Anderson.
95. ♂	Hammam Meskoutine, Prov. Constantine	Dr. J. Anderson.
96. Yg.	Oasis of Old Biskra	Dr. F. Werner.
97–104. Larvæ	Algeria	M. Héron-Royer.
105–106. ♀ & hgr.	Tunis	P. L. Sclater, Esq.

2. *Bombinator igneus*, Laur.

1–3. ♂ ♀	Kullen, Christianstadt, Scania	Prof. Lilljeborg.
4–6. ♂, ♀, & yg.	Seeland, Denmark	Prof. C. F. Lütken.
7–12. Larvæ	Seeland	Prof. C. F. Lütken.
13–22. ♂, ♀, & hgr.	Berlin	G. A. Boulenger.
23. ♂, skel.	Berlin	G. A. Boulenger.
24–33, 34–40. ♂, ♀, & yg.	Magdeburg	Herr W. Wolterstorff.
41–42. ♂ ♀	Magdeburg	M. Héron-Royer.
43–47. Larvæ	Magdeburg	M. Héron-Royer.
48. Hgr.	Ammendorf, near Halle, S.	Herr W. Wolterstorff.
49–51. ♂ ♀	Liegnitz, Silesia.	Herr W. Wolterstorff.
52–55. ♂ ♀	Prague	Prof. A. Fritsch.
56–57. ♀	Vienna	Dr. F. Hochstetter.
58. ♂, skel.	Vienna	Dr. F. Werner.
59. ♀, skel.	Vienna	Dr. F. Hochstetter.
60. ♂	Prater, Vienna	Dr. F. Werner.
61. ♀	St. Andrä-Wörden, Vienna	Dr. F. Werner.
62–63. ♂ ♀	Laxenburg, Lower Austria	Dr. F. Werner.
64–67. ♂ ♀	Höflein, Lower Austria	Dr. F. Werner.
68–69. ♂ ♀	Holics, Hungary	Prof. L. v. Méhely.
70. ♂	Charkow	Dr. J. de Bedriaga.

3. *Bombinator pachypus*, Bp.

A. Forma *typica*.

1–2. ♂	Florence	Prof. H. H. Giglioli.
3–4. ♂	Sta. Suzanna, near Rieti, Umbria	Dr. D. Vinciguerra.
5–7. ♀	Arsoli, Rome	Dr. D. Vinciguerra.
8–17. ♂ ♀	Potenza, Basilicata	Count M. Peracca.
18–19. ♀	Aprigliano, near Cosenza, Calabria	Dr. D. Vinciguerra.
20–21. ♂	Serra San Bruno, Calabria	Prof. H. H. Giglioli.
22–24. ♂ ♀	Italy (?)	
25. Ad., skel.	Italy (?)	

B. Var. *brevipes*, Blasius.

1–2. ♀ & yg.	Elbeuf, Normandy	M. Gadeau de Kerville.
3. ♀	Elbeuf	Dr. Grosclaude.
4–5. ♂ ♀	Sarthe	M. A. Gentil.
6. ♂	Pontlevoy, Loir-et-Cher	M. R. Parâtre.

7–8. ♂	Argenton, Indre	M. R. Parâtre.
9. Larva	Gironde	M. F. Lataste.
10–13. Larvæ	France	M. Héron-Royer.
14–23. ♂, ♀, & yg.	Near Dinant, Belgium	G. A. Boulenger.
24–33. ♂, ♀. & yg.	Mondorf, Luxemburg	G. A. Boulenger.
34. ♂, skel.	Mondorf, Luxemburg	G. A. Boulenger.
35–43. Larvæ	Mondorf, Luxemburg	G. A. Boulenger.
44–45. ♂ ♀	Basle	Dr. F. Müller.
46–55. ♂, ♀, & yg.	Freiburg, Baden	G. A. Boulenger.
56–65. Larvæ	Freiburg, Baden	G. A. Boulenger.
66. ♀	Frankfort (Main)	Prof. O. Boettger.
67–71. Larvæ	Niederfellendorf, Franconia	Herr W. Wolterstorff.
72. Yg.	Hanover	Dr. J. E. Gray.
73. ♂	Goslar, Harz	Prof. W. Peters.
74. ♀	Tiefenort, near Eisenach	Herr W. Wolterstorff.
75–77. ♂	L. Starnberg, near Munich	Herr W. Wolterstorff.
78–80. ♂, ♀, & yg.	San Romedio, S. Tyrol	M. E. de Betta.
81–88. ♂ ♀	Marcellise, Prov. Verona	M. E. de Betta.
89. ♀	Hütteldorf, near Vienna	Dr. F. Werner.
90–92. ♂ ♀	Grinzing, near Vienna	Dr. F. Werner.
93–94. ♂ ♀	Schemnitz, Hungary	Prof. L. v. Méhely.
95–96. ♀ & hgr.	Trieste	Dr. F. Werner.
97–98. ♂ ♀	Rijka, Montenegro	Dr. F. Werner.
99–108. ♂, ♀, & yg.	Parnassos	Dr. T. Krüper.

4. *Alytes obstetricans*, Laur.

A. Forma *typica*.

1–3. Larvæ	Boulogne-sur-Mer	Prof. A. Giard.
4–5, 6–7. ♂ with eggs	Paris	
8–13. ♂, ♀, & eggs	Paris	M. F. Lataste.
14. ♀	Paris	M. Héron-Royer.
15–24, 25–31. Larvæ	St. Germain-en-Laye, near Paris	G. A. Boulenger.
32. Yg.	Huelgoat, Finistère	O. Thomas, Esq.
33–34. ♂ ♀	French Jura	H. Ling Roth, Esq.
35. ♀, skel.	French Jura	H. Ling Roth, Esq.
36–41. Larvæ	Lac Bleu, near Cauterets, Pyrenees, 6500 ft.	Dr. L. Joubin.
42–43. ♂ ♀	Near Liége	G. A. Boulenger.
44–53. Larvæ	Maurenne, Prov. Namur	G. A. Boulenger.
54–55. ♂	Mondorf, Luxemburg	G. A. Boulenger.
56. ♂	Bonn	Dr. A. Günther.
57. ♂, skel.	Bonn	Dr. A. Günther.
58–60. Larvæ	Bonn	Dr. J. de Bedriaga.
61–62. ♂	Hameln, on the Weser	Herr W. Wolterstorff.
63–66. Larvæ	Freiburg, Baden	Dr. J. de Bedriaga.
67. Larva	Ballaigues, Switzerland	Dr. J. de Bedriaga.

B. Var. *boscæ*, Lataste.

1–2. Larvæ	Corunna	M. V. L. Seoane.
3–6. Larvæ	Coimbra	Dr. J. de Bedriaga.
7–8. Larvæ	Serra Estrella, Portugal	Dr. H. Gadow.

9–10. ♂	Oporto	E. Allen, Esq.
11. ♂	Valencia	Lord Lilford.
12–20. ♂, ♀, & hgr.	Valencia	M. E. Boscá.
21. ♂, skel.	Valencia	M. E. Boscá.
22–27. Larvæ	Valencia	M. E. Boscá.

5. *Alytes cisternasii*, Boscá.

1–3. ♂ ♀	Merida, Spain	M. E. Boscá.
4–7. Larvæ	Sierra Morena	M. E. Boscá.
8. ♂	Mertola, Portugal	M. F. A. Moller.

6. *Pelodytes punctatus*, Daud.

1. ♂	Paris	G. A. Boulenger.
2–3. ♂, skel.	Paris	G. A. Boulenger.
4–5. ♂ ♀	Paris	M. Héron-Royer.
6–12. Larvæ	Paris	M. Héron-Royer.
13. ♂	Near St. Malo	G. A. Boulenger.
14–23, 24–33. Larvæ & yg.	Near St. Malo	G. A. Boulenger.
34. ♀	Nantes	
35–39. ♂ ♀	Near Nice	Dr. J. de Bedriaga.
40, 41. Eggs	Near Nice	Dr. J. de Bedriaga.
42–51. Larvæ	Cimiez, near Nice	Dr. J. de Bedriaga.
52–53. Hgr.	France	Paris Museum.
54–55. ♂	Castino, Piedmont	Count M. Peracca.
56–65. ♂ ♀	Valencia	Lord Lilford.
66–68. ♂	Seville	Prof. Calderon.

7. *Pelobates fuscus*, Laur.

1–2. ♂ ♀	Paris	M. Héron-Royer.
3–4, 5–6. ♂ & yg.	Paris	
7–9. Larvæ	Paris	M. Héron-Royer.
10. ♀, skel.	Bondy, near Paris	
11. ♂	Drancy, Seine-et-Oise	M. R. Parâtre.
12. ♂	Nantes (?)	
13–14. ♂	Neudorf, near Basle	Dr. F. Müller.
15–16. Larvæ	Near Basle	Dr. F. Müller.
17–18. ♀ & hgr.	Hanover	Dr. J. E. Gray.
19–23. ♂ ♀	Halle/S.	Herr W. Wolterstorff.
24–33. Larvæ	Halle/S.	Herr W. Wolterstorff.
34–37, 38–40. ♂, ♀, & hgr.	Magdeburg	Herr W. Wolterstorff.
41, 42. ♂ ♀, skel.	Magdeburg	Herr W. Wolterstorff.
43. Eggs.	Magdeburg	Herr W. Wolterstorff.
44–46. ♂	Berlin	G. A. Boulenger.
47–48. ♂	Breslau	G. A. Boulenger.
49. Hgr.	Seeland, Denmark	Prof. C. F. Lütken.
50–53. Larvæ	Seeland	Prof. C. F. Lütken.
54–63. Larvæ	Prague	Herr V. Fritsch.
64–65. ♂ ♀	Prater, Vienna	Dr. F. Werner.
66–68. ♂ ♀	Floridsdorf, near Vienna	Dr. F. Werner.
69–71. ♂ ♀	Westerneuburg, near Vienna	Dr. F. Werner.
72–75, 76. ♂ ♀	Szamos Ujvar, Transylvania	Prof. L. v. Méhely.

77. ♂, skel.	Szamos Ujvar	Prof. L. v. Méhely.
78–81, 82. ♂ ♀	Turin	Count M. Peracca.
83, 84. ♂, skel.	Turin	Count M. Peracca.
85–86. ♂ ♀	Milan	Prof. Cornalia.
87. Larva	Bologna	Prof. J. J. Bianconi.

8. *Pelobates cultripes*, Cuv.

1. ♂	Nantes	Paris Museum.
2–3. ♂ ♀	S. France	M. Héron-Royer.
4. ♂, skel.	S. France	M. Héron-Royer.
5–6. Larvæ	Hérault	M. Héron-Royer.
7. ♀	France	
8–12. ♂, ♀, & yg.	Merida, Spain	M. E. Boscá.
13. ♂	Seville	Prof. Calderon.
14. Yg.	Spain	Lord Lilford.
15. ♀	Abrantes, Portugal	Dr. H. Gadow.
16–17. Larvæ	Tondella, Portugal	Dr. J. de Bedriaga.
18–19. Larvæ	Coimbra	Dr. J. de Bedriaga.

9. *Bufo vulgaris*, Laur.

1. ♀	Argyllshire	W. Eagle Clarke, Esq.
2–3. ♂ ♀	Edinburgh	W. Evans, Esq.
4, 5. ♀	Isle of Arran	Mus. Leach.
6. ♀	Devonshire	Mus. Leach.
7. ♂	Chiddingfold, Surrey	G. A. Boulenger.
8. ♂, skel.	Chiddingfold	G. A. Boulenger.
9. ♀	Spring Grove, Middlesex	Mus. Leach.
10–19. Larvæ	Epping Forest, Essex	G. A. Boulenger.
20. Eggs & embryos	Epping Forest	G. A. Boulenger.
21. ♀, skel.	England	
22, 23. ♀	Jersey	G. A. Boulenger.
24. ♀	Jersey	J. Hornell, Esq.
25. ♀	Paris	G. A. Boulenger.
26–27. ♂ ♀	St. Germain-en-Laye, near Paris	M. Héron-Royer.
28–32. Larvæ	Nice	Dr. J. de Bedriaga.
33. Yg.	Gerardmer, Vosges	M. A. Dollfus.
34–36. ♂ & yg.	Seeland, Denmark	Prof. C. F. Lütken.
37–40. Larvæ	Seeland	Prof. C. F. Lütken.
41. ♀	Bozau, Hungary	Prof. L. v. Méhely.
42–43, 44. ♀	Corunna	M. V. L. Seoane.
45. ♀	Valencia	Lord Lilford.
46, 47. ♂ ♀	Oporto	E. Allen, Esq.
48, 49. ♀	Gerez, Portugal	Dr. L. Vieira.
50–51. ♂ ♀	Bologna	Prof. J. J. Bianconi.
52. ♀	Sicily	
53. ♀	Athens	C. W. Merlin, Esq.
54. ♂	Algiers	Dr. J. Anderson.
55–56. ♂ & yg.	Chaborowka, Ussuri R.	Dr. J. G. Fischer.
57–61. ♂ ♀	Seoul, Corea	Dr. J. G. Fischer.
62. Hgr.	Chemulpo, Corea	C. W. Campbell, Esq.

63. Hgr.	Gensan, Corea	J. H. Leach, Esq.
64–67. ♂♀	Chefoo	R. Swinhoe, Esq.
68. ♂	Chefoo	Miss Reid.
69, 70. ♀ & hgr.	Shanghai	R. Swinhoe, Esq.
71–72. ♀ & hgr.	Ichang	A. E. Pratt, Esq.
73. ♀	Moh-si-Min, Prov. Sze Chuen, 1700 ft.	A. E. Pratt, Esq.
74, 75–76, 77–78	Chusan	Dr. Cantor.
79–82. Hgr. & yg.	Chusan	
83–86. ♂, ♀, & hgr.	Japan	Leyden Museum.
87. ♂	Japan	Sir A. Smith.
88. ♂	Kobe, Japan	Challenger Expedition.
89. ♂	Dagoshima, Japan	Dr. J. Anderson.

10. *Bufo viridis*, Laur.

1. ♀	Magdeburg	Herr W. Wolterstorff.
2. Eggs	Magdeburg	Herr W. Wolterstorff.
3. ♀	Berlin	G. A. Boulenger.
4–13. Larvæ	Breslau	Prof. G. Born.
14. Larva	Bonn	Dr. J. de Bedriaga.
15. ♂	Frankfort (Main)	G. A. Boulenger.
16. ♂, skel.	Frankfort (Main)	G. A. Boulenger.
17–21. Larvæ	Feldmoching, near Munich	Herr W. Wolterstorff.
22–24. ♂♀	Germany	
25. Hgr.	Island of Sprogö, Denmark	Prof. C. F. Lütken.
26. ♀	Szamos Ujvar, Hungary	Prof. L. v. Méhely.
27. ♂	Baleares	G. A. Boulenger.
28–31. ♂♀	Ibiza, Baleares	Prof. E. Boscá.
32, 33–34. ♀ & yg. (albinos)	Turin	Prof. Bonelli.
35–37. ♂♀	Turin	Count M. Peracca.
38–42. Larvæ	Turin	Prof. L. Camerano.
43–45. ♂, ♀, & yg.	Verona	M. E. de Betta.
46–47. Larvæ	Pizzo, Calabria	Prof. H. H. Giglioli.
48–53. Larvæ	Ischia	Prof. C. F. Lütken.
54. ♀	Corte, Corsica	Prof. H. H. Giglioli.
55–56. ♂♀	Italy	M. Héron-Royer.
57–58. Larvæ	Italy	M. Héron-Royer.
59–60. ♂ & yg.	Korito, Herzegovina, 3300 ft.	Dr. F. Werner.
61. Yg.	Capljina, Herzegovina	Dr. F. Werner.
62–63. ♂♀	Athens	A. Smith Woodward, Esq.
64–68. ♂, ♀, & hgr.	Salonica	J. Southgate, Esq.
69. ♀	Pera, Constantinople	Dr. E. D. Dickson.
70–72. ♂♀	Crete	Baron v. Maltzan.
73. Hgr.	Moscow	Moscow University.
74. ♀	Tedschen, near Merv	Warsaw Museum.
75. Yg.	Crimea	B. L. Hawkins, Esq.
76. ♂	Kirghiz Steppes	Moscow University.
77–79. ♂♀	Xanthus, Asia Minor	Sir C. Fellows.
80. ♀	Cilician Taurus	C. G. Danford, Esq.
81. ♀	Albistan, Cilician Taurus	C. G. Danford, Esq.

82. Hgr.	Cyprus	Lord Lilford.
83–85. ♀ & hgr.	Cyprus	Herr H. Rolle.
86. ♀	Damascus	Dr. J. Anderson.
87. ♂	Berket Atach, Syria	Dr. T. Barrois.
88. ♀	Mount Carmel	Canon Tristram.
89. ♂	Jericho	Dr. J. Anderson.
90–92. ♂ ♀	Dead Sea	Canon Tristram.
93. ♀	Sinaitic Peninsula	H. C. Hart, Esq.
94–96. Yg.	Midian, Arabia	Sir R. Burton.
97, 98. ♂ & yg.	Euphrates	Captain Chesney.
99. Hgr.	Kurdistan	
100. Yg.	Near Resht, N. Persia	W. T. Blanford, Esq.
101. ♂	Bushire	Mr. J. A. Murray.
102–103. ♂ ♀	Near Bam, S.E. Persia	W. T. Blanford, Esq.
104. Hgr.	Between Quetta and Nushki	Dr. J. Aitchison.
105–106. ♂	Bala Morghab, Afghanistan	Dr. J. Aitchison.
107–116. Larvæ	Do Shak, Afghanistan	Dr. J. Aitchison.
117–118. ♂ ♀	Lepsa, Ala Tau	Dr. O. Finsch.
119–123. ♂ ♀	R. Ili	Rev. H. Lansdell.
124–125. ♀	Kashgar	Rev. H. Lansdell.
126–135. ♂ & yg.	Balti, Tibet	Messrs. v. Schlagintweit.
136. Yg.	Tibet	T. C. Jerdon, Esq.
137–140. Yg.	Casablanca, Morocco	Senckenberg Museum.
141. Yg.	Between Oran and Tlemsen	Dr. J. Anderson.
142–143. ♂ ♀	Oran	Dr. J. de Bedriaga.
144. ♀	El Mrayer, Algerian Sahara	Dr. F. Werner.
145. ♂	Algeria	Canon Tristram.
146–152. ♂, ♀, & hgr.	Tripoli	
153. ♂	Alexandria	M. Héron-Royer.
154. ♀	Ramleh, near Alexandria	Dr. J. Anderson.
155. ♂	Egypt	Vienna Museum.
156. ♂	Egypt	J. Burton, Esq.
157–159. Hgr.	Egypt	M. Lefebvre.

11. *Bufo calamita*, Laur.

1–2, 3–6. ♂, ♀, yg., & eggs	Southport, Lancashire	Warrington Museum.
7–9, 10–19. Yg. & larvæ	Wallasey, Cheshire	Warrington Museum.
20–22. Hgr.	E. Norfolk	P. H. Emerson, Esq.
23–24. ♂ ♀	Cambridgeshire	
25–26. ♂	Blackheath, near London	
27. Hgr.	Co. Kerry, Ireland	Dr. Purcell.
28–29. ♂	Castlemaine Harbour, co. Kerry	W. R. Robinson, Esq.
30. ♀, skel.	Castlemaine Harbour	W. R. Robinson, Esq.
31. ♀	Calais	Dr. W. Leach.
32–39. ♂, ♀, & hgr.	Near St. Malo	G. A. Boulenger.
40. ♂, skel.	Near St. Malo	G. A. Boulenger.
41–50. Larvæ	Near St. Malo	G. A. Boulenger.
51–52. ♂ ♀	Paris	M. Héron-Royer.
53. ♀	Ostend	G. A. Boulenger.

54–63. ♂, ♀, & yg.	Heyst-s.-M., Belgium	G. A. Boulenger.
64–65. ♂ ♀	Mesnil-St.-Blaise, Prov. Namur, Belgium	G. A. Boulenger.
66. Eggs	Mesnil-St.-Blaise	G. A. Boulenger.
67–69. ♂ ♀	Mondorf, Luxemburg	G. A. Boulenger.
70–71. Yg.	Hamburg	Dr. Tricke.
72–73. ♂	Brunswick	Dr. Heller.
74–75. Hgr. & yg.	Seeland, Denmark	Prof. C. F. Lütken.
76. ♂	Corunna	M. V. L. Seoane.
77. ♂	Madrid	Lord Lilford.
78–82. ♂, ♀, & yg.	Seville	Prof. Calderon.
83. ♂	Oporto	E. Allen, Esq.
84. ♀	Minas de S. Domingo, Alemtejo	Dr. H. Gadow.
85–89. Larvæ	Mertola, Portugal	Dr. J. de Bedriaga.

12. *Hyla arborea*, L.

A. Forma *typica*.

1. ♂	Near St. Malo	G. A. Boulenger.
2–11, 12–21. Larvæ & yg.	Near St. Malo	G. A. Boulenger.
22–23. ♂	Mesnil-St.-Blaise, Prov. Namur, Belgium	G. A. Boulenger.
24–25. ♂	Hamburg	Dr. Tricke.
26. ♂	Harz	
27. Eggs	Magdeburg	Herr W. Wolterstorff.
28. ♂, skel.	Munich	Dr. L. Will.
29. ♀	Island of Bornholm, Baltic	Prof. C. F. Lütken.
30. ♀, skel.	Near Vienna	Dr. F. Werner.
31. ♂	Pressburg, Hungary	Prof. L. v. Méhely.
32. ♀	Transylvania	C. G. Danford & J. A. H. Brown, Esqs.
33. Hgr.	Charkow	Dr. J. de Bedriaga.
34. ♀	Corunna	M. V. L. Seoane.
35. ♂	Victoria Alaba, Spain	Lord Lilford.
36. ♂	Ciudad Real	M. E. Boscá.
37. ♀	Coimbra	Mr. F. A. Moller.
38. ♀	Ravenna	M. R. Parâtre.
39. ♂	Ferrieare, Apennines	Prof. G. B. Howes.
40. Hgr.	Guezama, Italy	Sir W. C. Trevelyan.
41–42. ♂ ♀	Serra S. Bruno, Calabria	Prof. H. H. Giglioli.
43. ♂	Zante, Ionian Islands	Dr. F. Werner.
44–46. ♀	Crete	Baron v. Maltzan.
47. ♀	Giaour Dagh, Asia Minor	C. G. Danford, Esq.

B. Var. *savignyi*, And.

1. ♂	Elba	Sir W. C. Trevelyan.
2–3. ♀ & yg.	Sassari, Sardinia	Dr. J. de Bedriaga.
4. ♀	Asia Minor	Haslar Collection.
5. ♀	Cyprus	Lord Lilford.
6–9. ♂ ♀	Cyprus	Herr H. Rolle.
10–11. ♂ ♀	Lake Bamas, Syria	Prof. T. Barrois.

12–13.	Yg. & larva	Ain-el-Mousaich, Syria	Prof. T. Barrois.
14.	♀	Lake of Galilee	H. W. Beddome, Esq.
15–17.	♂ ♀	Wady-el-Kurm	Canon Tristram.
18–19.	♂ ♀	Dead Sea	Canon Tristram.
20–29.	♂ ♀	Euphrates	
30.	♂, skel.	Euphrates	
31–32.	Hgr.	Near Resht, N. Persia	W. T. Blanford, Esq.
33.	♀	Fao, Persian Gulf	W. D. Cumming, Esq.
34.	♂	Kazerun, S. Persia	S. Butcher, Esq.
35.	Yg.	Seoul, Corea	C. W. Campbell, Esq.
36–37.	♀ & yg.	Gensan, Corea	J. H. Leech, Esq.
38.	Hgr.	Hainan	R. Swinhoe, Esq.
39.	♂	Ichang	A. E. Pratt, Esq.
40–42.	♀ & hgr.	Japan	Leyden Museum.
43–45.	♀ & yg.	Japan	J. H. Leech, Esq.
46–47.	♂ ♀	Kobe, Japan	Challenger Expedition.
48.	♀	Kiga, Japan	Dr. J. Anderson.
49.	♀	Daibutz, Japan	Dr. J. Anderson.
50.	Yg.	Osen Mountain, Shimabara	Mr. Holst.
51–52.	♀ and yg.	Tsu Shima	Mr. Holst.

c. Var. *intermedia*, Blgr.

1.	♀	Bologna	Prof. J. J. Bianconi.
2.	♀	Palermo	Prof. O. Boettger.

d. Var. *meridionalis*, Bttgr.

1–3.	♂ ♀	Gironde	M. F. Lataste.
4–13.	Yg. & larvæ	Near Nice	Dr. J. de Bedriaga.
14.	Eggs	Near Nice	Dr. J. de Bedriaga.
15–16.	♂ ♀	Cannes	A. Gepp, Esq.
17–19, 20–21.	♂ ♀	S. France	M. Héron-Royer.
22.	♂	Cabeza del Buzy, Spain	M. E. Boscá.
23–28.	♂ ♀	Seville	Prof. Calderon.
29.	♂	Seville	Dr. H. Gadow.
30–32.	Hgr.	Minas de S. Domingo, Alemtejo	Dr. H. Gadow.
33.	♂	Pegli, near Genoa	Prof. Poulton.
34.	♂	Bologna	Prof. J. J. Bianconi.
35–40.	♂ ♀	Tangier	M. H. Vaucher.
41–42.	♂ ♀	Hammam Meskoutine, Algeria	Dr. J. Anderson.
43.	♂, skel.	Hammam Meskoutine	Dr. J. Anderson.
44–46.	♂	Tunis	P. L. Sclater, Esq.
47, 48–49.	♀ & hgr.	Madeira	P. B. Webb, Esq.
50–51.	♂	Teneriffe	R. MacAndrew, Esq.
52–54.	♂ ♀	Canary Islands	P. B. Webb, Esq.

13. *Rana esculenta*, L.

A. Var. *ridibunda*, Pall.

EUROPE.

1–10. ♂, ♀, hgr., & yg.	Cadillac, Gironde	M. F. Lataste.
11–14. ♂ ♀	Corunna	M. V. L. Seoane.
15–19. Larvæ	Coimbra	Dr. J. de Bedriaga.
20–25. ♂, ♀, & hgr.	Serra de Gerez	Dr. H. Gadow.
26–27. ♂ ♀	Upper Douro, Tras os Montes	Dr. H. Gadow.
28–31. ♂ ♀	Oporto	Dr. H. Gadow.
32–34. ♂ ♀	Serra Estrella	Dr. H. Gadow.
35–43. ♂, ♀, hgr., & yg.	Alemtejo	Dr. H. Gadow.
44–46. ♂, ♀, & hgr.	Cintra	Dr. H. Gadow.
47–50. Hgr. & yg.	Algarve	Dr. H. Gadow.
51. ♂	Seville	M. V. L. Seoane.
52. ♀	Seville	Prof. Calderon.
53. ♂	S. Spain	M. F. Lataste.
54–63, 64–73. ♂, ♀, hgr., & yg.	Berlin	G. A. Boulenger.
74–75. ♂ ♀	Berlin	M. Héron-Royer.
76. ♀, skel.	Berlin	G. A. Boulenger.
77–82. ♂ ♀	Salziger See, near Halle/S.	Herr W. Wolterstorff.
83–85. Yg.	Magdeburg	Herr W. Wolterstorff.
86–89. ♂ ♀	Warsaw	Prof. Wrzeniowski.
90–95. ♂ ♀	Prague	Herr V. Fritsch.
96–105. Larvæ	Prague	Herr V. Fritsch.
106–109. ♂ ♀	Laaerberg, near Vienna	Dr. F. Werner.
110. ♀	Körös-Ladany, Hungary	Prof. L. v. Méhely.
111. ♀	Hungary	Lord A. Russell.
112. ♀	Hungary	
113–114. Hgr. & yg.	Travnik, Bosnia	Dr. F. Werner.
115. Hgr.	Brěka, Bosnia	Dr. F. Werner.
116–120. ♂, ♀, & yg.	Capljina, Herzegovina	Herr Trebitzky.
121–122. Yg.	Zara, Dalmatia	Dr. F. Werner.
123–124. ♂ & yg.	Budua, S. Dalmatia	Dr. F. Werner.
125–126. ♀ & yg.	Rijka, Montenegro	Dr. F. Werner.
127. ♂	Santa Maura, Ionian Islands	Dr. F. Werner.
128. Hgr.	Olenos, Peloponnesus	Dr. F. Werner.
129–130. ♂ ♀	Athens	Dr. J. de Bedriaga.
131–132. Yg.	L. Stymphalos, N. Morea	J. Norman Douglass, Esq.
133. ♀	Crete	Baron v. Maltzan.
134–143. ♂, ♀, hgr., & yg.	European shore of the Bosphorus	Dr. E. D. Dickson.
144–145. ♂ ♀	Astrachan	St. Petersburg Mus.
146–147. ♂ ♀	Daghestan, Caucasus	Moscow University.

ASIA.

148. ♀	Kirghiz Steppes	Moscow University.
149–152. ♂ ♀	Ielenowka, L. Gokcha	St. Petersburg Mus.
153–155. ♂ ♀	Elisabethpol	St. Petersburg Mus.
156. ♀	Lenkoran	St. Petersburg Mus.

157–158. ♀	Suchum Kalé, Transcaucasia	St. Petersburg Mus.
159–162. Yg.	L. Abran, near Suchum Kalé	St. Petersburg Mus.
163–164. ♀	Kubatlu, Karabagh	Senckenberg Mus.
165–166. Yg.	Nukus, Amu Daria	St. Petersburg Mus.
167–170. ♀ & yg.	Chinas, Turkestan	St. Petersburg Mus.
171–177. ♂,♀,&yg.	Guermab, S.W. of Ashkabad	Warsaw Mus.
178–179. ♂ & hgr.	Turbat, Afghanistan	Dr. Aitchison.
180. Larva	Between Quetta and Nushki	Dr. Aitchison.
181–182. ♂ ♀	Near Sarawan, Baluchistan	G. E. Mason, Esq.
183. Hgr.	Bussorah	W. J. Blanford, Esq.
184. ♀	Shiraz	W. J. Blanford, Esq.
185–194. ♂,♀,&yg.	Fao, Persian Gulf	W. D. Cumming, Esq.
195–200. ♂ ♀	Kazerun, Persia	S. Butcher, Esq.
201. ♀	Mesopotamia	Euphrates Expedition.
202. Yg.	Albistan, Cilician Taurus	C. G. Danford, Esq.
203–208. ♂ ♀	Fener-bahtchi, Asiatic side of Sea of Marmora	Dr. E. D. Dickson.
209–210. ♂ ♀	Smyrna	
211. ♀	Cyprus	Lord Lilford.
212. ♂	Damascus	Dr. J. Anderson.
213–214. ♀	Damascus	Dr. T. Barrois.
215–216. ♂ ♀	Beit-Jenn, near Damascus	Dr. T. Barrois.
217. ♀	Birket Atneh, Damascus	Dr. T. Barrois.
218. ♀	Sea of Galilee	Canon Tristram.
219–220. ♂	Plains of Phœnicia	Canon Tristram.
221. ♂	Merom	Canon Tristram.
222–223. ♂ ♀	Dead Sea	Canon Tristram.
224. ♂	Jericho	Dr. J. Anderson.
225–226. ♀ & hgr.	Sinaitic Peninsula	H. C. Hart, Esq.

AFRICA.

227. ♂	Alexandria	M. Héron-Royer.
228–229. ♀	Tunis	Mr. Fraser.
230. Yg.	Susa, Tunisia	Mr. Fraser.
231–240. ♂,♀,&yg.	Constantine	P. L. Sclater, Esq.
241–244. ♂ & yg.	Hammam R'irha, Algeria	Dr. J. Anderson.
245–247. ♀	Biskra	Dr. J. Anderson.
248–251. Larvæ	Algeria	M. Héron-Royer.
252–256. ♀	Tangier	M. H. Vaucher.
257–258. Yg.	Casablanca, Morocco	Senckenberg Mus.
259–265. ♂ ♀	Madeira	Prof. C. F. Lütken.
266–267. ♀ & yg.	Madeira, 4500—5000 ft.	Hon. C. Baring and W. R. Ogilvie Grant, Esq.
268–271. ♂,♀,&yg.	Azores	F. D. Godman, Esq.

B. Forma *typica*.

1, 2. ♂	Foulden, Norfolk (introduced)	Lord Amherst of Hackney
3–10, 11–12. ♂,♀, & hgr.	Near St. Malo	G. A. Boulenger.
13–22. Larvæ	Near St. Malo	G. A. Boulenger.

23–24. ♂♀	Paris	G. A. Boulenger.
25. ♀, skel.	Paris	
26–27. ♂♀	Argenton, Indre	M. R. Parâtre.
28–37. ♂, ♀, & yg.	Heyst-s.-M., Belgium	G. A. Boulenger.
38–44. ♂, ♀, hgr., & yg.	Brussels	G. A. Boulenger.
45. ♀	Anseremme, Prov. Namur, Belgium	G. A. Boulenger.
46–48. Hgr.	Mondorf, Luxemburg	G. A. Boulenger.
49. ♀	Baden	J. Norman Douglass, Esq.
50–59. Larvæ	Freiburg, Baden	G. A. Boulenger.
60. ♀	L. Starnberg, near Munich	Herr W. Wolterstorff.
61–68. ♂♀	Basle	Dr. F. Müller.
69–73. ♂♀	Zofingen, Aargau	Dr. F. Müller.
74–78. ♂♀	Mount Saleve, near Geneva	Dr. F. Müller.
79. Yg.	Hanover	Dr. J. E. Gray.
80–86, 87–90, 91–95, 96–98. ♂, ♀, hgr., & yg.	Berlin	G. A. Boulenger.
99–102. ♂♀	Copenhagen	Prof. C. F. Lütken.
103–107. ♂♀	Lolland	Prof. C. F. Lütken.
108–113. ♂♀	Warsaw	Prof. Wrzeniowski.
114–115. Hgr.	Moscow	Moscow University.
116–118, 119. ♂♀	Prater, Vienna	Dr. F. Werner.
120. ♂, skel.	Prater	Dr. F. Werner.
121–122. ♂♀	Neusiedl L., Hungary	Dr. F. Werner.
123–124. ♀ & yg.	Nice	Dr. J. de Bedriaga.
125–126. ♂♀	Mouth of R. Var	Dr. J. de Bedriaga.
127. ♀	Verona	M. E. de Betta.
128–133. ♂, ♀, & yg.	Rivoli, Prov. Verona	M. E. de Betta.
134–136. ♂♀	Calcinaro, Prov. Verona	M. E. de Betta.
137–139. ♀	Mestre, Prov. Venice	M. E. de Betta.
140–142, 143–144. ♂, ♀, & yg.	Bologna	Prof. J. J. Bianconi.
145–146. Larvæ	Bologna	Prof. J. J. Bianconi.
147–153. ♂, ♀, hgr., & yg.	Florence	Prof. H. H. Giglioli.
154–155. ♀	Pisa	Prof. H. H. Giglioli.
156–159. ♂♀	Naples	Dr. F. S. Monticelli.
160–162. ♂♀	Corsica	Dr. J. de Bedriaga.
163. ♀	Corsica	M. A. Dollfus.
164. ♂	Corte, Corsica	Prof. H. H. Giglioli.

c. Var. *lessonæ*, Camer.

1–3, 4–6. ♂, ♀, hgr., & yg.	Foulmire Fen, Cambridgeshire	W. Yarrell, Esq.
7–12, 13. ♂, ♀, hgr., & yg.	Stow Bedon, Norfolk	Lord Walsingham.
14–18. Yg.	Stow Bedon	G. E. Mason, Esq.
19–20. ♂♀	Berchem-St.-Agathe, near Brussels	G. A. Boulenger.
21–23. ♂♀	Mesnil-St.-Blaise, Prov. Namur, Belgium	G. A. Boulenger.

24. ♂, skel.	Mesnil-St.-Blaise	G. A. Boulenger.
25–28. ♂♀	Hilden, near Dusseldorf	W. F. Kirby, Esq.
29–32. ♂, ♀, & hgr.	Offenbach	Dr. J. de Bedriaga.
33. ♀	Cröllwitz, near Halle	Herr W. Wolterstorff.
34. ♀	Szamos-Ujvar, Hungary	Prof. L. v. Méhely.
35–43. ♂, ♀, hgr., & yg.	Piedmont	Prof. L. Camerano.
44. ♀, skel.	Piedmont	Prof. L. Camerano.
45. ♀	Malta (?)	Zoological Society.

D. Var. *chinensis*, Osb.

1–2. Hgr.	S. slope of Khingham Mountains, E. Mongolia	G. E. Mason, Esq.
3. ♀	Broughton Bay, Corea	G. E. Mason, Esq.
4. ♀	Gensan, Corea	J. H. Leech, Esq.
5. ♀	Japan	J. H. Leech, Esq.
6–8, 9–10. ♂♀	Japan	Leyden Museum.
11–17. ♂, ♀, & yg.	Central Japan	Dr. J. Anderson.
18. ♀	Yokohama	Dr. J. Anderson.
19. ♂	Hakone Lake, Japan	Dr. J. Anderson.
20. ♂	Great Loo Choo	G. E. Mason, Esq.
21–28. ♂, ♀, hgr., & yg.	Chefoo	R. Swinhoe, Esq.
29. ♀	Chefoo	Miss Reid.
30–35, 36–38, 39–40. ♂, ♀, hgr., & yg.	Shanghai	R. Swinhoe, Esq.
41. Hgr.	Ketau Pt., Che Kiang	J. J. Walker, Esq.
42. Yg.	Hang Chau, Che Kiang	J. J. Walker, Esq.
43. ♀	Chusan	
44-45. ♀ & hgr.	Mountains north of Kiu Kiang	A. E. Pratt, Esq.
46–47, 48. ♂, ♀, & yg.	Ningpo	R. Swinhoe, Esq.
49–51. Yg.	Bangkok, Siam	G. E. Mason, Esq.

14. *Rana arvalis*, Nilss.

1, 2–4. ♂, ♀, & yg.	Sweden	Prof. Sundevall.
5. ♀, skel.	Upsala	G. A. Boulenger.
6. Yg.	Göteborg	Dr. A. W. Malm.
7, 8–10. ♂, ♀, & hgr.	Hval Oerne, S. Norway	Prof. R. Collett.
11–12. ♂♀	Seeland, Denmark	Prof. C. F. Lütken.
13–14, 15. ♂♀	Copenhagen	M. Héron-Royer.
16–19. Larvæ	Copenhagen	M. Héron-Royer.
20–29. ♂, ♀, hgr., & yg.	Berlin	G. A. Boulenger.
30–39. ♂, ♀, & yg.	Breslau	Prof. G. Born.
40–49. Larvæ	Breslau	Prof. G. Born.
50. ♂, skel.	Breslau	G. A. Boulenger.
51. ♂	Schkenditz, near Leipzig	Herr W. Wolterstorff.
52–53. Yg.	Halle/S.	Herr W. Wolterstorff.
54–63. Larvæ	Halle/S.	Herr W. Wolterstorff.
64–66, 67–70. ♂, ♀, & yg.	Magdeburg	Herr W. Wolterstorff.

71. ♂	Osterburg	Herr W. Wolterstorff.
72. ♀	Hanover	Dr. J. E. Gray.
73–74. ♀ & yg.	N. Germany	Dr. J. E. Gray.
75–76. ♂	Neudorf, near Basle, Alsace	Dr. F. Müller.
77–81, 82–86. ♂, ♀, hgr., & yg.	Marchfeld, Lower Austria	Dr. F. Werner.
87–88. ♂ ♀	Györ, Raab, Hungary	Prof. L. v. Méhely.
89–94. ♂ ♀	Szamos-Ujvar, Transylvania	Prof. L. v. Méhely.
95. ♂	Karlovac, Sclavonia	Herr V. Fritsch.
96–97. ♂ ♀	Nijni-Novgorod, Oural	Dr. J. de Bedriaga.

15. *Rana camerani*, Blgr.

1. ♀	Kurush, Daghestan, 8000 ft	Dr. G. Radde.
2. ♂	L. Talizhuri, 8000 ft.	Dr. G. Radde.
3. ♂	Gilli, L. Gokcha	Senckenberg Mus.
4–5. Yg.	Central Karabagh Mts., E. Armenia	Senckenberg Mus.
6–9. ♂, hgr., & yg.	Kasikoporan, W. Armenia, 6500 ft.	Dr. G. Radde.
10. ♀, skel.	Kasikoporan	Dr. G. Radde.
11. Yg.	Albistan, Cilician Taurus	C. G. Danford, Esq.
12–17. Hgr. & yg.	Maidan Goel, Cilician Taurus, 8000 ft.	Herr Martin Holtz.

16. *Rana temporaria*, L.

1–3. ♂ ♀	Cannisbay, Caithness	Dr. J. Anderson.
4. ♂	Kinlochewe, Ross-shire	W. R. Ogilvie Grant, Esq.
5. ♀	Skye	H. R. Leach, Esq.
6–9. ♀ & yg.	Glen Avon, Banffshire	W. R. Ogilvie Grant, Esq.
10. ♂	Dunphail, Moray	W. R. Ogilvie Grant, Esq.
11. ♂	Auchimblae, Kincardineshire	Prof. P. J. White.
12–19. ♂, ♀, & yg.	Scotland	
20–21. ♀	E. Norfolk	P. H. Emerson, Esq.
22–23. ♂ ♀	Hampton, Middlesex	Mr. E. Dodson.
24–30. ♂ ♀	Near London	G. A. Boulenger.
31, 32. Eggs	London	G. A. Boulenger.
33–42. Larvæ	Near London	G. A. Boulenger.
43. ♀	Exeter	Museum Leach.
44, 45. ♂ ♀, skel.	England	
46–51. ♂ & yg.	Glengariff, co. Kerry	Dr. R. Scharff.
52–53. ♂ ♀	W. Kerry	Capt. Combie.
54. ♀	Killarney	Rev. E. Eaton.
55–56. ♂	Dundrum, co. Dublin	Dr. R. Scharff.
57. ♂	Matsjok, Tana, E. Finmark	Prof. R. Collett.
58. ♀	Tromsö Dal, Norway	H. N. Ridley, Esq.
59. ♂	Dovre Mountains, Norway	Prof. R. Collett.
60–61. ♂ ♀	Seeland, Denmark	Prof. C. F. Lütken.
62–66. Larvæ	Seeland	Prof. C. F. Lütken.

67–70. ♂ ♀	Near St. Malo	G. A. Boulenger.
71–75. ♂ ♀	Wimereux, near Boulogne	Prof. A. Giard.
76–77. ♂ ♀	Paris	M. Héron-Royer.
78–83. ♂, ♀, & hgr.	Heyst-s.-M., Belgium	G. A. Boulenger.
84–90. Larvæ	Anseremme, Prov. Namur, Belgium	G. A. Boulenger.
91–94. ♂ ♀	Mondorf, Luxemburg	G. A. Boulenger.
95. ♀	Altenahr	W. F. Kirby, Esq.
96. ♂	Cassel	G. C. Norman, Esq.
97–104. ♂, ♀, hgr., & yg.	Hanover	Dr. J. E. Gray.
105–106. ♀	Breitnau, Baden, 3265 ft.	G. A. Boulenger.
107–111. Larvæ	Breitnau	G. A. Boulenger.
112–115. Hgr.	Breslau	Prof. G. Born.
116–122. ♂ ♀	Prague	Prof. A. Fritsch.
123. ♀	Tömös Valley, Hungary	Prof. L. v. Méhely.
124–125, 126–130. ♂ ♀	Corunna, Spain	M. V. L. Seoane.
131. ♂	Bernina, Alps, 8600 ft.	M. A. Dollfus.
132–134. ♂ ♀	Alps, near Nice	Dr. J. de Bedriaga.
135–137. ♂ ♀	Cuneo, Piedmont	Count M. Peracca.
138–139. ♂ ♀	Ossola, Piedmont	Prof. L. Camerano.
140–146. Larvæ	Rossassa, Alpes de Biella, 3100 ft.	Prof. L. Camerano.
147–156, 157–160. Larvæ	Ceresole Reale, 5600 ft.	Prof. L. Camerano.
161–170. Larvæ	Alpe la Vecchia, Biellese, 7000 ft.	Prof. L. Camerano.
171–172. ♂	Mount Pelsa, Bellunine Alps, 8600 ft.	M. E. de Betta.
173. ♂	Mount Ducan, Bellunine Alps, 5300 ft.	M. E. de Betta.
174–175. ♀	Monte Lessini, Prov. Verona	M. E. de Betta.
176–183. ♂, ♀, & yg.	Fondo and Tret, S. Tyrol	M. E. de Betta.
184. ♀	St. Petersburg	St. Petersburg Mus.
185–192. ♂, ♀, & yg.	Moscow	Moscow University.
193. Hgr.	Novgorod	St. Petersburg Mus.
194–196. ♂ ♀	Ilisk, E. Turkestan	Rev. H. Lansdell.
197. Hgr.	Kuku-Nor, Mongolia	St. Petersburg Mus.
198. ♂	Abrek Bay, near Vladivostok, Manchuria	Dr. Dybowsky.
199–203. ♀ & yg.	Yesso, Japan	Dr. J. Anderson

17. *Rana græca*, Blgr.

1–2, 3–6. ♂ ♀	Monte Morello, near Florence	Count M. Peracca.
7. ♂, skel.	Monte Morello	Count M. Peracca.
8–11, 12–15. ♂ ♀	Siena, 2600 ft.	Count M. Peracca.
16. ♀, skel.	Siena	Count M Peracca.
17. ♂	Tajce, Bosnia	Prof. E. Brandis.
18. Yg.	Rijka, Montenegro	Dr. F. Werner.
19. Hgr.	Olenos, Peloponnesus	Dr. F. Werner.
20–29. Larvæ & yg.	Parnassos, 3000 ft.	Dr. T. Krüper.

30. Hgr.	Parnassos	Dr. J. de Bedriaga.
31–36. ♂ & yg.	Hills above Klimenti, N. Morea	J. Norman Douglass, Esq.

18. *Rana iberica*, Blgr.

1–3, 4–11. ♂, ♀, & yg.	Serra de Gerez	Dr. H. Gadow.
12–13. ♂ ♀	Coimbra	Dr. H. Gadow.
14. ♀, skel.	Coimbra	Dr. H. Gadow.
15–17. ♂, ♀, & yg.	Coimbra	M. F. A. Moller.
18–19. Larvæ	Coimbra	Dr. J. de Bedriaga.
20. Yg.	Murça, Tras os Montes	Dr. H. Gadow.
21–22. Larvæ	Portugal	M. Héron-Royer.

19. *Rana latastii*, Blgr.

1–8, 9. ♂ ♀	Turin	Count M. Peracca.
10. ♀, skel.	Turin	Count M. Peracca.
11. Eggs	Turin	Count M. Peracca.
12–13. ♂ ♀	Novara, Piedmont	Prof. L. Camerano.
14–15. ♂	Varese, Lombardy	Prof. L. Camerano.
16–18. Yg.	Bertonico, near Lodi, Lombardy	M. E. de Betta.
19. ♀	Padua	M. E. de Betta.
20–24. ♂ ♀	Calcinaro, Prov. Verona	M. E. de Betta.
25. ♀	Monte Lessini, Prov. Verona	M. E. de Betta.
26–28. ♀ & hgr.	Venice	Prof. L. Camerano.
29–30. ♂ ♀	Treviso	M. E. de Betta.
31–35. ♂, ♀, & yg.	Castelfranco, Prov. Treviso	M. E. de Betta.
36. ♂, skel.	Castelfranco	M. E. de Betta.
37–38. ♂ ♀	Cordovado, Prov. Udine	M. E. de Betta.
39. ♀, skel.	Cordovado	M. E. de Betta.
40–41. ♂	Florence	Prof. H. H. Giglioli.
42. Larva	Italy	M. Héron-Royer.

20. *Rana agilis*, Thom.

1. ♂	Jersey	L. Greening, Esq.
2. ♂	Jersey	J. Hornell, Esq.
3–12. ♂, ♀, hgr., & yg.	Near St. Malo	G. A. Boulenger.
13–22. Larvæ	Near St. Malo	G. A. Boulenger.
23. ♂	Elbeuf, Normandy	Dr. Grosclaude.
24–25. ♂	Paris	M. F. Lataste.
26, 27. ♂ ♀, skel.	Paris	G. A. Boulenger.
28–29, 30–31. ♂ ♀	Bondy, near Paris	M. Héron-Royer.
32–33. Larvæ	Near Paris	M. Héron-Royer.
34. ♂	Kundraditz, near Prague	Herr W. Wolterstorff.
35–37. ♂	Galitzin Berg, Vienna	Dr. F. Werner.
38. ♀	Prinzing, near Vienna	Dr. F. Werner.
39–41. ♂ ♀	Hütteldorf, near Vienna	Dr. F. Werner.
42. ♂	Oroszveg, Comm. Bereg, Hungary	Prof. L. v. Méhely.

43–46. ♂ ♀	Turin	Count M. Peracca.
47. Eggs	Turin	Count M. Peracca.
48–49. ♀ & yg.	Padua	M. E. de Betta.
50–51, 52–56. ♂ ♀	Marcellise, Prov. Verona	M. E. de Betta.
57–58. ♂ ♀	Bologna	Prof. J. J. Bianconi.
59–61. ♂	Florence	Count M. Peracca.
62. Hgr.	Spalato, Dalmatia	M. E. de Betta.
63. Yg.	Budua, S. Dalmatia	Dr. F. Werner.
64. ♂	Travnik, Bosnia	Dr. F. Werner.
65–66. Hgr.	Lenkoran, Transcaucasia	Herr H. Leder.

BIBLIOGRAPHICAL INDEX.

THIS list does not aim at anything like a complete bibliography. I have merely given references to works or papers to which I have had occasion to refer in preparing this account of the European Batrachians, which have been alluded to in the Introduction, or which may prove of use to the reader desirous of making himself more fully acquainted with the subject. Modern contributions, therefore, predominate in this selection; only standard works among those of older date have found a place in this index.

Works of purely systematic scope, or descriptive of isolated genera and species, are left out as being sufficiently referred to in the Synonymies heading the account of every species.

I. GENERAL, ANATOMICAL, AND PHYSIOLOGICAL.

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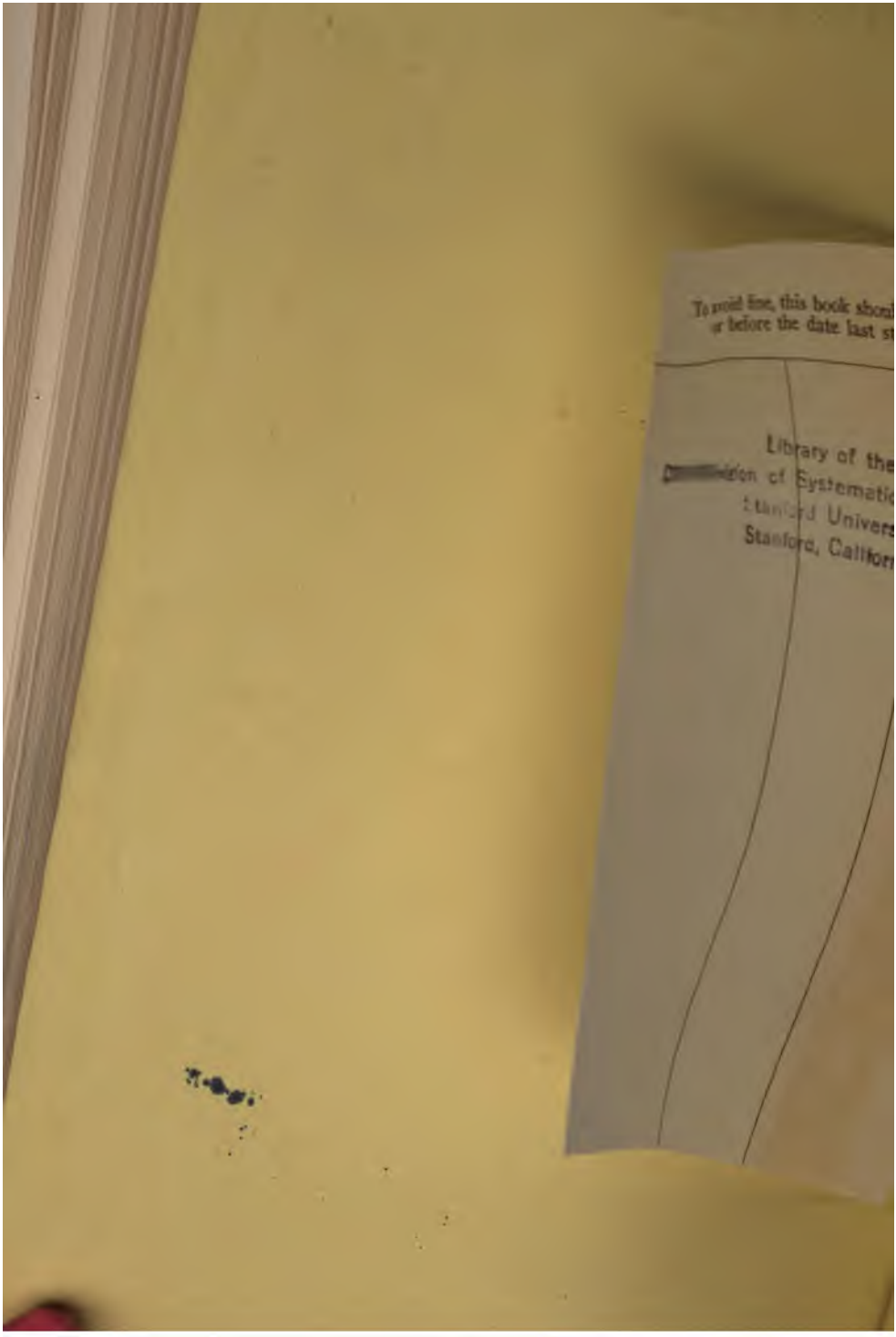
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